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Power Station Sites

FACTORS WHICH LIMIT CHOICE

FUNDAMENTAL to the generation of electricity is the choice of suitable sites for power stations. A good site is an asset that is permanent so far as engineering developments can be foreseen, since the plant installed thereon when it becomes obsolete can be replaced. Some stations, indeed, return lower overall costs, because of their favourable location, than others of higher thermal efficiency which are topographically less well placed.

Growing Complexity

Siting, which is dependent mainly on abundant water supplies, proximity (if possible) to points of demand for electricity, easy rail, road and water access and adequate housing for operatives, assumes greater importance and becomes more complex as the scale of electricity production grows.

In this country the position presents more difficulties than in many others. Sir John Hacking (deputy chairman, B.E.A.) has pointed out that the larger inland catchment areas in the United States in relation to population centres generally provide ample water for condenser cooling, thus obviating the need for cooling towers. He has also found that the better quality of coal burned in power stations there (even though in pulverized form), in addition to minimizing the problem of ash disposal, has led to greater boiler availability with consequent reductions of capital, operation and maintenance charges—advantages that have been improved upon by methods of erection and overhaul that have notably lessened the idle time of plant.

The need to burn low-grade coal seems not to be so great a preoccupation in the United States as it is in Great Britain. Here, as Dr. A. Parker (director of Fuel Research, D.S.I.R.) stated in his recent Thomas Hawkesley lecture, scarce coals of good quality must not be squandered for purposes for which more plentiful kinds can be used. For the latter, the electricity supply industry has long provided an expanding market. It will, no doubt, do more when applied research has enabled colliery products, not worth transporting, to be economically burned at pit-head cooling-tower stations on the lines discussed by Mr. B. L. Metcalf in the paper he presented before the Institution of Mining Engineers, which was reported in our issue of 28th October. Site conditions will usually limit the capacity of such stations for reasons given by Messrs. E. Forth and J. B. Jackson before the Institute of Fuel (reported in the same issue)—one example being possible "sterilization" of coal beneath the station foundations.

Expediency and Amenity

These authors show that, since river-water cooling of condensers in large modern stations takes far more than the minimum flow of most fresh-water rivers, base-load stations will generally have to be built on tidal estuaries or, if inland, rely upon cooling towers. The chief objection to these on the part of outside critics (which often delays the erection of urgently

needed new stations) is aimed at their height, as it is in the case of power station chimneys. Desirable as it is to preserve those local amenities which are not merely regarded as such from an ultra-conservative angle, the choice is often likely to be the harsh one of either . . . or . . . Power stations designed to guarantee electricity at a price the public (and particularly industry) can afford to pay cannot be operated with any approach to efficiency except on a limited number of sites that have the characteristics outlined above.

WATER HEATER TAX

Recently the purchase tax on electric storage water heaters was reduced to 66⅔ per cent—the rate applied to gas water heaters. The tax on immersion heaters remains at 100 per cent in spite of representations showing that the tax is unjustiable either as a "luxury" tax or as a means of reducing electricity peaks. And yet Sir Stafford Cripps told the House of Commons recently that the tax was maintained because the Minister of Fuel and Power advised him that immersion heaters contributed largely to the peak load. The fact is that these heaters, being used largely in conjunction with solid-fuel boilers, have little or no effect on the peak. Perhaps Mr. Gaitskell will have another word with the Chancellor on the subject.

RURAL DOUBT

If the Electricity Boards know where they stand in the matter of rural development the farming community does not. Mr. Tom Williams, Minister of Agriculture, in the House of Commons early this month, assured farmers that the proposed economies in expenditure would not appreciably reduce the farm improvement programme. The electricity authorities were anxious to extend power to the countryside as rapidly as possible. Last week, also in the House of Commons, Mr. Gaitskell, Minister of Fuel and Power, said that the cuts in the capital expenditure of the Electricity Boards would fall largely upon the distribution side and make an acceleration of rural electrification impossible in the immediate future. The Government must make up its mind about these "cuts" and we suggest again that there is ample scope for retrenchment outside the electricity supply industry.

SHORT AND LONG VIEWS

Much as we need to earn dollars we are compelled to consider our "regular" customers. Mr. Leslie Gamage, the president of the Institute of Export, was right in pressing this point at the Institute's dinner last week. Mr. Gamage said that the "hard-currency" drive and bilateral agreements with countries which were not our natural markets should not prevent us from supplying the requirements of those who had stood by us during the war and offered us a long-term market in place. Otherwise there would be bitterness and misunderstanding and foreign competitors would become entrenched in these markets.

DISTRICT HEATING

Such accounts as have appeared in the daily papers of the use of "waste heat from Battersea power station for heating the new housing estate in Westminster" may be misleading. As the article on page 1259 shows, the exhaust steam so used will come, not from the main turbines, but from two 1,350 kW sets to be installed for supplying power to drive the station auxiliaries. These small units, although generating electrical energy inefficiently, allow of the highly efficient use of the heat in the steam. They are designed to give an exhaust temperature of over 200 deg F, whereas the main turbines must exhaust to a condenser at about 80 deg F in order to generate electricity for public supply at a reasonable cost. In this instance the distribution of the heat to users does not appear likely to present any considerable problems.

COAL TAR AT BANKSIDE?

After all the discussion there has been on the subject of oil fuel for the new Bankside (London) power station, including numerous questions in the House of Commons, the British Electricity Authority is investigating the possibilities of using coal tar as fuel there. The results of the investigation will be awaited with some interest by power engineers and the public.

Medium Power Rectification

Comparison of Rotary with Static Systems

By H. REIK, M.Sc.(Eng.), A.M.I.E.E.

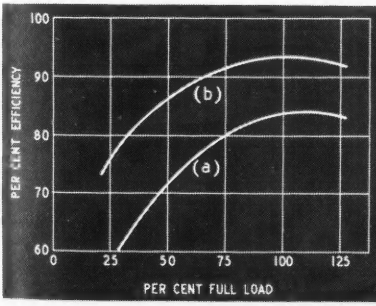
POWER rectification requirements may be broadly divided into three groups, rated at from 0 to 5 kW, from 5 to 500 kW (medium) and from 500 kW upward.

The four main available types of medium power equipment for converting a.c. into d.c. are: (a) motor-generator; (b) rotary convertor; (c) mercury-arc rectifier; and (d) metal rectifier. A fifth type, the mechanical (switching) synchronous rectifier, was used with some success in Germany during the war, especially for furnishing large currents at low and medium voltages. It is now being manufactured in the United States and an efficiency of 95 per cent has been claimed, but it is not made in Britain. The main problem is to secure trouble-free commutation, which is the reason for its exclusion from the above classification.

Main considerations when selecting systems of rectification are (1) characteristics of the equipment relative to duty requirements; (2) maintenance; (3) primary and overall costs; these may be compared in the following way.

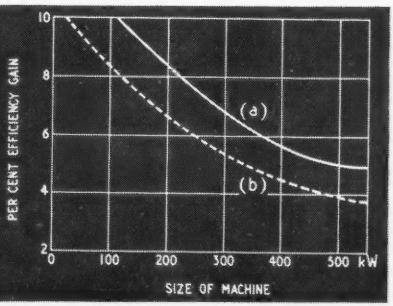
1 (a) The disadvantage of the m-g set, consisting of two electrically independent machines, coupled by one shaft, is the additive losses of two machines which are a considerable percentage at light load. The great advantage is the ease with which the output voltage can be controlled by adjusting the field excitation. This is one of the reasons why m-g sets are still extensively used for the Ward-Leonard system of varying the speed of driven plant, although mercury arc rectifiers have lately invaded this field. When studying the performance characteristic (Fig. 1a) note that the efficiency increases with its power.

1 (b) The rotary convertor, a single armature with input sliprings at one end and output commutator at the other, started by an auxiliary motor on the same shaft, needs to have its input voltage corrected by a variable transformer, or induction regulator. The advantage is that internal losses are less than those of a single machine because the a.c. and d.c. components combine in the armature, but this may lead to unequal loss distribution inside the machine. To make the fullest use of the advantage, six-phase input connection is usually recommended. The transformer thus



(a) Motor-generator set, (b) Rotary convertor without transformer

Fig. 1.—Performances of 100 kW machines



(a) Rotary against m-g. (b) Rotary with transformer against m-g

Fig. 2.—Efficiencies of rotating machines

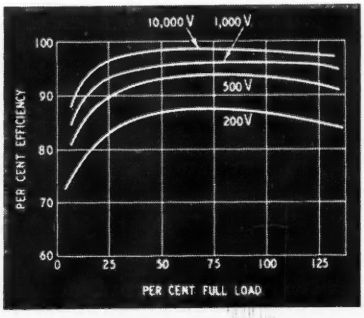


Fig. 3.—200 kW mercury rectifiers with transformers

serves the dual purpose of providing hexaphase input from three-phase supply mains and of keeping the voltage derived from the mains below (in definite fixed ratio) the output voltage. The comparison (from Hill: "Rotary Convertors") of the better efficiency of the rotary convertor against that of the motor-generator (Fig. 2 (a)) did not allow for transformer efficiency; the dotted (Fig. 2 (b)) difference curve shows the necessary correction.

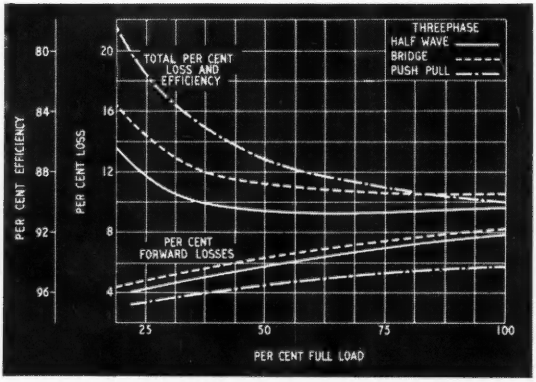
1 (c) All types of mercury arc rectifiers require special input transformers which afford at least slight voltage control. If desired, grid controlled rectifiers can be used; alternatively, induction regulators or variable voltage transformers are supplied. Both glass bulb and metalclad mercury rectifiers have the same characteristics and performance. The output voltage is related to the input voltage and the number of phases.

Both glass bulb and metalclad units have been known to operate for periods of fifteen years or more without a decrease in vacuum and the mercury diffusion pumps used in the early stages of rectifier development to maintain the vacuum are being dispensed with. Glass bulb units are commonly used for anode outputs up to 400 A while metalclad units are made from 200 A upward. Rectifier losses are determined by the arc and anode drop in voltage, which can vary between 15 and 30 V according to type and duty. As these losses remain constant, even at high voltages, the total loss within the rectifier itself is a function of the current passed. This gives a very high bulb efficiency at over 1,000 V. Transformer losses have to be added, giving a set of characteristic curves (Fig. 3) for various voltages.

1 (d) Metal rectifiers have proved themselves during the last fifteen years as reliable and robust conversion units. Copper oxide units are not now much used for power applications. The selenium rectifier tends to dominate this field because the copper oxide disks will not stand up to more than 5 V in the reverse direction whereas selenium types are made to work at up to 29 V per disk. Even this limit may be exceeded in the not too distant future as experimental units have been run at 50 V per disk.

The output voltage is a function of the applied voltage and the rectifier circuit. If it must be variable, an induction regulator or variable input voltage transformer has to be used. Rectifier transformers are commonly employed, but the rectifier can be connected directly to the mains if the d.c. thus obtained happens to be at a voltage that will suit the particular application.

Fig. 4.—Metal rectifier efficiencies and losses



Losses are governed by circuit conditions and design. It can generally be assumed that no-load (reverse) losses are light and

that the main losses are a function of the current. Due to the fact that metal rectifiers are asymmetric non-ohmic resistances, the forward losses do not increase as the square of the current because the resistance decreases with increase of current.

The typical losses and efficiencies for three different three-phase circuits (Fig. 4) operating at 24 V/disk (a.c.) do not include the transformer losses. When allowing for the latter the maximum efficiency in this case would be about 88 per cent. As metal rectifiers are built up by connecting single disks in series and parallel to achieve the desired voltage and current capacities, the efficiencies will be the same from a comparatively small current and low voltage upward.

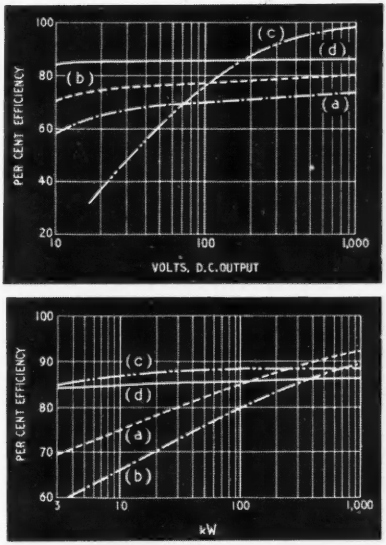
Power rectifiers are generally oil immersed and the size of the unit is governed by the fact that the selenium type should not be operated at over 60 deg C for long periods in order to avoid undue ageing, which would increase the forward resistance with corresponding decrease of output voltage and efficiency. Metal types are not commonly used for over 250 kW. Outputs of over 20,000 A have been delivered for plating purposes.

Typical performance curves of 50 kW sets at various d.c. output voltages, assuming 50 per cent of full load and three-phase input, show that the metal rectifier (Fig. 5 (d)) gives the best performance up to about 180 V, above which the mercury arc rectifier is more efficient. Both rotary machines would give slightly better results on full load and (Fig. 6)

TABLE I.—TYPE COMPARISON

	Motor-generator	Rotary convertor	Mercury arc	Metal rectifier
Voltage control	By excitation	Transformer or induction regulator	Grid and transformer	Transformer or induction regulator
Maintenance	Two rotating machines and exciter	One rotating machine	No rotating parts (cooling fan)	No rotating parts
Efficiencies at full load	60 - 90% increasing with size	70 - 95% increasing with size	40 - 97% increasing with voltage (75% at 100 V)	80 - 90% for three-phase circuits independent of voltage or size

Fig. 5.—Performance of 50 kW units at half load
(a) M-g set. (b) Rotary convertor with transformer. (c) Mercury rectifier with transformer. (d) Selenium rectifier with transformer



(a) M-g set. (b) Rotary convertor with transformer. (c) Mercury rectifier with transformer. (d) Metal rectifier with transformer

Fig. 6.—Relative efficiencies for 220 V output

shows clearly that the rotary convertor (and even the m-g set) will have a good efficiency at high powers, again with an assumed average running condition of 50 to 75 per cent of full load.

2 (a) and (b). The floor space occupied by a rotary convertor with transformer is about the same as that needed for a motor-generator set of the same capacity. The arrangement is, however, more convenient as the transformer can be placed away from the convertor. Having less rotating mass, the convertor is more reliable and should need less maintenance than the m-g and exciter.

2 (c) and (d). The floor space occupied by a mercury arc rectifier is less than that required for a comparative m-g or rotary convertor set from about 50 kW upward; above that capacity the metal rectifier needs more floor space when naturally cooled.

Mercury arc rectifiers only need regular

inspection of the control gear, as the bulbs need no maintenance, although the operation of the starter anodes should be watched. Metal rectifiers, being oil immersed, need no maintenance apart from checking the oil levels and any auxiliaries employed.

3. While it is difficult briefly to make a true comparison of primary and overall costs, for 50 kW sets delivering d.c. at between 10 and 1,000 V, Fig. 7 shows that the cost/kW improves slightly (and is very similar) at higher voltage for both machines and the metal rectifier, while the cost of the mercury arc rectifier falls considerably with increase of voltage. This is due to the fact that each mercury bulb is designed for a particular current and its kW rating increases directly in proportion to the voltage employed. The total cost is, however, the sum of transformer, control gear and bulb costs, and is thus not in such a simple relationship.

For under 2,300 V the cost of the m-g set is about equal to that of the rotary convertor, including its transformer, and is therefore shown in one line. Metal and mercury rectifier transformers are very similar, although those of the metal type are slightly smaller as no provision for short circuits during commutation (through the arc) has to be made. The overall costs (Fig. 8) of the same units take into account maintenance, a ten-hour working day and efficiencies, indicating that metal rectifiers govern the choice under 190 V and mercury arc rectifiers the higher range; convertors are a reasonable second at higher voltages.

No further improvements in efficiency can be expected from motor-generator and convertor sets or mercury arc rectifiers in the near future. Mercury rectifiers have reached a high pitch of efficiency and further improvements will only affect their control equipment. It is the metal rectifier which holds out promise of improved performance. The working voltage of some units has recently been increased well above 14-18 V with corresponding increases in efficiency.

While one cannot expect changes overnight, it is reasonable to assume that 29 V disks will eventually become standard for power rectifiers delivering d.c. at more than 10 V, which would lead to a reduction of primary and overall running costs. A metal rectifier with 40 V disks would push its competitive working range into the 500 V region with maximum efficiencies of 92 to 94 per cent.

TABLE II.—COST COMPARISON*

	Cost ratio at	Type			
		Motor gen.	Rotary Conv.	Mercury Arc	Metal rect.
Primary cost	(a) d.c. 30 V	100	100	180	95
	(b) d.c. 100 V	100	100	115	95
	(c) d.c. 220 V	100	100	95	105
	(d) d.c. 600 V	100	100	60	115
Operating cost	(a) d.c. 30 V	100	95	150	75
	(b) d.c. 100 V	100	94	95	80
	(c) d.c. 220 V	100	93	90	93
	(d) d.c. 600 V	100	90	55	98

* Assuming 50 kW motor-generator set to represent 100, including cost of control gear. The tabulated figures have been compiled from price lists and other publications, so are only a general guide. In the case of a 500 kW set there would be a narrower margin between the mercury rectifier and rotary machines at higher voltages.

Fig. 7.—Primary costs of 50 kW units
(a) M-g set. (b) Rotary convertor. (c) Mercury rectifier. (d) Metal rectifier

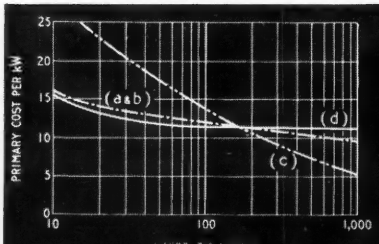
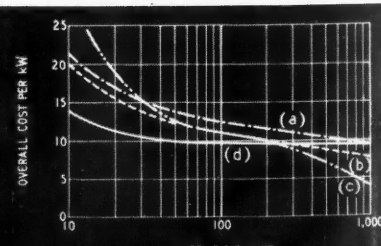


Fig. 8.—Overall operating costs of 50 kW sets
(a) M-g set. (b) Rotary convertor. (c) Mercury rectifier. (d) Metal rectifier



Views on the News

By REFLECTOR

IT was fascinating to see Philip Harben cook a Christmas dinner in one of last week's television programmes but disappointing in one respect—he used a gas cooker. Now I am told by the British Electrical Development Association that Mr. Harben has agreed to use an electric cooker in his future demonstrations at least as often as a gas cooker. With members of the E.D.A. staff he was shown a number of electric cookers and selected one. His choice was influenced by the medium. A drop-down oven door enables the camera to come in from either side and the switches are on one level to make it easier to follow the movement of his hand. Rapid boiling plates will be fitted although they are not standard on the chosen model. I congratulate E.D.A. (and Mr. Harben) on the steps taken to see that electricity gets a fair show in these effective demonstrations.

★ ★ ★

In spite of protests by some passengers, the Washington Public Utilities Commission has ruled that there is nothing illegal or unconstitutional in the provision of radio music in the city's trams. Here we are up against the same problem as is encountered with "Music While You Work:" one man's meat is another man's poison, i.e., the constant pumping out of modern rhythm may drive the music-lover to distraction. But if the Washington trams and tracks are anything like those on the Victoria Embankment the question will not arise, for nothing will be heard above the racket.

★ ★ ★

The case in support of the Welsh water power proposals was, I thought, admirably put by Mr. A. R. Cooper, the B.E.A. divisional controller for Merseyside and North Wales, in the recent B.B.C. discussion on "Is our Countryside Threatened?" He contended that the critics who believed they were opposing ugliness were in fact just opposing change. The problem they should be tackling was to see that the change was for the good. He pointed out that power engineers also liked climbing mountains and viewing beautiful scenes. They did not agree that hydro-electric schemes must necessary detract from that beauty, and he quoted what had been done in other countries. I myself wonder whether some of the people who have decried the alleged "vandalism" know what a water power station is. One article on the subject in a daily paper a little while ago was illustrated by an impressive sketch of a pretty valley in which there appeared a power station complete with smoking chimney and cooling tower.

★ ★ ★

Two weeks ago I congratulated the South Eastern Electricity Board on the excellent "press" obtained for its price-reduction announcement. Now the South Eastern has been sadly eclipsed by the London Board, which has made its maximum flat-rate charge 5d per kWh (5½d through slot meters) against the South Eastern Board's 7d (8d for slot meters). Moreover, while the earlier announcement affected only 15,000 consumers, in London 268,600 will benefit. Further still, the secondary charge in London two-part commercial and domestic tariffs will not be higher than ⅞d. Unfortunately, the London Board has had to threaten "uneconomic" flat rate consumers with an early increase.

★ ★ ★

The *Yorkshire Evening Post* reports that a Leeds engineer claims to have invented "the only safe method to test a broken-down electrical circuit." This comprises "a radio-active valve, a little larger than the diameter of a three-penny piece, fitted into a small screwdriver." Demonstrating his device, the inventor placed the blade of the screwdriver on to the "feeder" cable. "The atomic valve glowed red. He put it to the 'return' cable. There was no glow." The inventor told a reporter: "If you had done that with an ordinary screwdriver you would have been killed." The "secret" was revealed as the use in the small valve of "a material similar to one of those used in atomic piles. The valve is filled with radio-active gas." I think I have seen something like this before.

Correspondence

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Inspection of Installations

SHORTLY after moving into a small house on the outskirts of London recently, the owner was notified by the Electricity Board of a number of matters which an inspection of the electrical installation had revealed as requiring attention, and was advised: "As the installation in its present condition may not be safe, it is recommended that you arrange with an electrical contractor for the defects to be remedied, and notify us as soon as this work has been completed."

Now, I am strongly in favour of any reasonable steps being taken to secure the safety of domestic installations and with many of the recommendations made in this particular case I am in full agreement. But the average consumer knows little or nothing as to what constitutes a safe installation. To confront him with an unexplained list of technical defects and inform him that his installation may not be safe is surely bad psychology; and to invite him to place himself trustingly in the hands of any contractor who may or may not be qualified to carry out the work required is, in my opinion, entirely wrong.

I emphatically do not advocate compulsory inspection of domestic installations; nevertheless, I believe many house-owners would welcome periodic inspection and advice by competent persons, either free of charge or for a small sum, and it might be a good idea if the Board were to offer its services in this connection.

If such inspections are undertaken, I suggest: (i) They should take place in the presence of the owner or his representative, to whom the defects should be explained. (ii) Recommendations should be confined strictly to matters of safety. (iii) The owner should be advised to have any necessary work carried out by a registered contractor and should be supplied with a list of the registered contractors in his district. He should also be informed that he may, if he wishes, submit the contractor's estimate to the Board for scrutiny and that if he so desires the Board will inspect the work during its execution and upon completion.

Some such scheme as this would be a safeguard not only against normal deterioration, but against the menace of the amateur electrician who strings up wiring and fittings in ignorance of the danger they constitute.

L. C. ROBERTS, A.M.I.E.E.

*Norbury, S.W.*16.

Opal Lamps

BEFORE the war many lamp manufacturers marketed opal b.c. lamps. For domestic applications where lights are exposed such lamps are ideal, since they provide an evenly diffused illumination free from glare. Their reintroduction is now overdue and they should be made available without further delay.

C. A. BAKER, M.P.O.A.

Birmingham.

[Few householders should wish to use exposed lamps; those who have to may not appreciate that opal-glass making increases furnace wear and tear. Consequential reduction of furnace capacity would be difficult to justify at the present time.—*Editors, Electrical Review.*]

Trade with Denmark

A COMPREHENSIVE report on the economic and commercial conditions in Denmark has been prepared by Mr. S. Simmonds, Counsellor (Commercial) to H.M. Embassy at Copenhagen, and published for the Board of Trade by H.M. Stationery Office at 2s net. This shows that the value of imports of electrical machinery, apparatus and material imported from the United Kingdom in 1948 totalled Kr 19,751,000, as compared with Kr 17,467,000 in 1947. Mr. Simmonds says the Danish Northern Cable & Wire Works, Ltd., has a virtual monopoly of the Danish market for electric cable and wire, and in 1947 it produced 6,703 tons of cable, covered wire and insulating material.

New Meter Standards

Their Bearing on Present Distribution of Domestic Consumers' Loads

By P. SCHILLER*
Dipl.-Ing., M.I.E.E.

IT is understood that the proposed revision of the British Standards Institution specification for electricity meters (draft BS.37) will limit the standard sizes of whole-current single-phase house service meters to three. It will specify limits of error of plus 2 per cent and minus 2.5 per cent between 100 and 50 per cent of the rated continuous maximum current (which in future is to be the "marked current") and of ± 2 per cent at 1.66 per cent (namely 1/60th) of the maximum current.

Some characteristic data (Table 1) have been calculated on the 240 V basis for comparison with the present distribution of the installed loads and the maximum demands (m.d.s) of existing domestic consumers.

Cumulative frequency - distribution graphs of estimated, or measured, individual maximum demands of consumers have been published in E.R.A. reports [1] and [3].

The accompanying diagram represents the following cumulative frequency distributions:—

(a) Installed loads of the sample of about 300 domestic-two-part tariff consumers from the London Area on which the E.R.A. investigation (3) was based; in the pre-nationalization undertakings concerned, roughly two-thirds of all domestic consumers were on the two-part tariff.

(b) Corresponding m.d.s. as recorded in 1948.

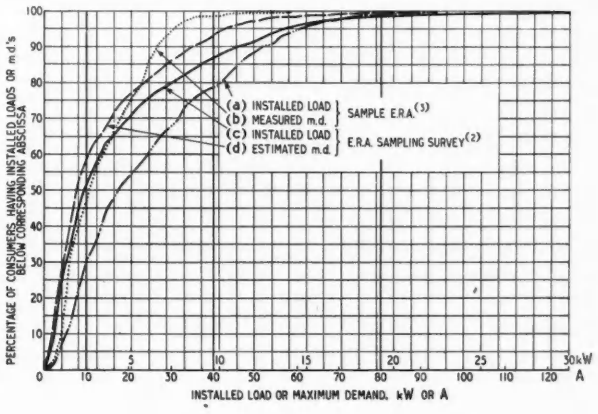
(c) Installed loads observed at re-visits in 1948 of a condensed sample of about 3,000 consumers, representative of those covered by the E.R.A. sampling survey [2].

(d) Corresponding estimated m.d.s, which curve has been obtained by assuming that for a given installed load the horizontal displacement would be approximately the same as between curves (b) and (a), but taking only half this value, so as to make a very conservative estimate. It is interesting to note that the ordinate at 10 A intersects curve (c) at about 50 per cent and curve (a) at 30 per cent. The difference of about 20 per cent equals the proportion of lighting-

* Head of Utilization Research Section, Commercial Department, British Electricity Authority.

Table 1—Meter Data Calculated for 240 V

Rating (max).		Starting load		Lower end of range of specified accuracy	
A	kW	A	W	A	W
10	2.4	0.025	6	0.17	40
40	9.6	0.1	24	0.67	160
80	19.2	0.2	48	1.34	320



Cumulative frequency distributions of individual consumer loads and demands in London

flat-rate consumers in the E.R.A. sampling survey.

The x-axis of the diagram is scaled in both kilowatts and amperes, and the ordinates corresponding to the three future standard meter sizes are emphasized.

From curve (d) it will be seen that if all meters installed at present were to be replaced by new meters of sizes based on actual m.d.s, at least 58 per cent could be of the 10 A type, 35 per cent of 40 A and less than 7 per cent would have to be 80 A.† In fact, however, the process of replacement will extend over many years, as obsolete meters are being gradually scrapped; and in the interim, there will be a certain shifting of curve (d) to the right, as installed loads and corresponding m.d.s grow.

In addition to the replacement of over-age meters, an estimate of future requirements of the three sizes of new standard meters will, of course, also have to take into account the exchange of meters that become too small for the increasing load to be carried, as well as those for new connections. The diagram will, however, be found of interest as providing a picture of the present distribution of installed loads and estimated m.d.s of domestic consumers.

† It has also to be borne in mind that the m.d. values plotted are 15- to 30-min values, whereas the meter ratings represent continuous loads. This leaves a margin for extensions, especially if the additional physical overload capacity is also considered.

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(1) K/T122 on "The Load of the Individua Domestic Consumer."

(2) K/T125a on "A Large-Scale Sampling Survey of Domestic Consumers."

(3) K/T127 on "Investigation of a Sample of Domestic Two-part-Tariff Consumers."

Northern Ireland Rural Policy

IN the Northern Ireland Parliament the Minister of Agriculture was asked whether he could state the number of applications received for grants towards the cost of installing plant for the generation of electricity on farms and the number approved; and whether all applicants had been informed that this scheme was suspended for the present.

The Minister replied that the number of applications for grants under the Agricultural Development Scheme for the installation of generating plant was 128 up to 10th December. No proposal for such a grant had yet been approved and a circular had been issued to applicants informing them that consideration of their proposals was being deferred pending a decision on the development of electricity distribution in rural areas.

The Minister added that the Agricultural Development Scheme provided for assistance to be given in the installation of generating plant only on farms where a supply of electricity was not likely to be made available from a distributing main. It was clear that the lines of future development of rural distribution in particular areas must be known with some degree of certainty before the Ministry could be satisfied that in the case of individual applicants for grant a public supply was not likely to be available.

The Minister of Commerce, Mr. W. McCleery, stated on 14th December that the Electricity Board for Northern Ireland had been instructed by the Government to proceed with development in the rural areas at a cost of about £900,000 in the next two years. It was estimated that this would enable a further 3,750 rural dwellings to be connected, bringing the total to about 5,500. The Minister referred to the reluctance of the Board to proceed at a rate which would result in a permanent deficiency in the accounts of the undertaking. It had now been decided that remedial measures would be considered at the end of the two-year period. In the meantime, an independent examination of the whole position would be made.

Sodium Lighting

A SUM of £5,300 is to be included in the draft estimates for 1950-51 of Luton Corporation for the purpose of replacing the existing gas lamps in Stockingstone Road, Montrose Avenue and Waller Avenue, with new sodium lighting units. The borough engineer has been authorized to make arrangements for the replacement by sodium lamps of the existing tungsten filament lamps in a section of Dunstable Road.

Barrow-in-Furness Corporation has approved a recommendation of the surveyor that sodium lighting shall be installed in part of Michaelson Road between Bridge Road and Ramsden Dock Road. If the tests prove to be satisfactory, the whole of route A.590 is to be illuminated by sodium lamps.

Personal and Social

NEWS OF MEN AND WOMEN OF THE INDUSTRY

IN our last issue we briefly reported the election of **Mr. E. W. Sugden,** B.Sc.Tech., A.M.I.E.E., as chairman of Parmiter, Hope & Sugden, Ltd., and his appointment as managing director in succession to the late Mr. V. Hope. Mr. Sugden was educated at Bowdon College, Cheshire. He took the degree of B.Sc.Tech. at the Manchester College of Technology and Arts, and received his early training in the drawing office of Parmiter, Hope & Sugden, Ltd., and in the Testing Department of the British Thomson-Houston Co., Ltd., Rugby and Birmingham. Thereafter he was employed first as an engineering estimator and afterwards, for about six years, as a sales engineer with Parmiter, Hope & Sugden. In 1936 Mr. Sugden was appointed a director of the company, and in 1946, when the company was made into a public company, he was appointed chief engineer and a director.

Mr. A. J. Richards has been appointed sales manager of Omega Lampworks, Ltd. Mr. Richards was previously with Thorn Electrical Industries, Ltd., having joined them in 1939. Before that he was with John E. Dallas & Sons, Ltd.

The Westinghouse Brake & Signal Co., Ltd., has appointed **Mr. R. J. Hogben,** brake sales engineer, to be assistant sales manager as from 1st January next.

The annual general meeting of the Birmingham Branch of the **Electrical Industries Benevolent Association** was held at the Midland Hotel, Birmingham, on 8th December and was preceded by a luncheon. The officers elected for 1950 were: President: Mr. F. W. Lawton. Vice-presidents: Messrs. J. Clement and A. H. Adey. Chairman: Mr. H. J. Gibson. Hon. secretary: Mr. L. Wall. A résumé was given of last year's activities, and it was announced that a dance will be held at the Tube Investments Social Club, Oldbury, on 17th February. Tickets (10s each) are obtainable from Mr. Wall, Electrical Components, Ltd., 102, Snow Hill, Birmingham.

Mr. Stephen J. Mattock has been appointed publicity manager to Venner Time Switches, Ltd. Mr. Mattock was formerly with Rolls-Royce, Ltd., the General Electric Co., Ltd., and lately with W. Edwards & Co. (London), Ltd.

Mr. B. Wray has now taken up his appointment in the north-east as lighting engineer, Adamson & Co. (Tyne), Ltd., the Newcastle-upon-Tyne distributors of Crompton Parkinson, Ltd. (Supplies Division). He was previously associated with Philips Electrical, Ltd., Lighting Department, London.

The G.E.C. Dramatic and Musical Societies produced a "Christmas Show" at Magnet House, Kingsway, from 12th to 17th December, during which 1,300 attended. There were seventeen separate items and a cast of fifty, all bubbling over with the Christmas spirit. Such well-known Christmas features as "Father Christmas," fairies, carollers, pantomime and Cinderella, with a magic carpet that transported one from "Winter in Torquay" to "London Town" and "Happy Hampstead" were all there. Deviser and producer of all this was William Peacock, who also appeared in a solo sketch, "The Demonstrator," and

G.E.C. Players in the Christmas Show recently produced at Magnet House

four other items. The carollers were the G.E.C. singers, backed by Messrs. M. Wilson, J. Hirst and C. West at the pianos. Two humorous skits were presented by Ronald Turner and Edward Ansell.

At the **Midland Electric Manufacturing Co.'s** Christmas lunch, on 14th December, sixty-one new members were admitted to the M.E.M. "Gold Watch Brigade" on completion of ten years' service with the company. This year, for the first time since the war, watches were actually presented and an announcement was made that those members who had had the wartime token award would now be allowed to exchange the temporary award for a gold watch. The M.E.M. Employees' Retirement Benefit Fund, introduced a year ago, provides a cash payment on employees' retirement, ranging from a maximum sum of £570 to a minimum of £50, according to length of service. No contributions are made by the employee, the cost of the scheme being borne entirely by the company. Six men and two women were presented with illuminated addresses, having completed twenty-one years' service.

Muirhead & Co., Ltd., Beckenham, Kent, held a Christmas dance at Kennards Restaurant, Croydon, when 850 employees and guests attended. Music was provided by Sidney Lipton and his ballroom orchestra from Grosvenor House. There was also a cabaret. All the directors were present.

Obituary

Mr. H. M. Sayers.—We briefly mentioned in last week's issue the death of Mr. Henry Mannington Sayers, M.I.E.E., on 20th December. Mr. Sayers was born at Isleworth in 1860 and was educated at the Telegraphists' School of Science, Finsbury, London, and at the City & Guilds of London Institute. He served as a telegraphist at the Central Telegraph Office, G.P.O., from 1874 to 1881, and then joined Brush and Hammond, becoming chief engineer of the Eastbourne Electric Lighting Co. After two years (1886-1887) in the outside contracts department of the Brush Electrical Co. he went to Portugal as engineer to the Oporto Electric Light Co., returning in 1894 to take up the position of engineer to the Bournemouth Electric Supply Co. In 1897-98 he was engineer to the English Electric Light Co., Madrid, and from 1898 to 1903 power engineer with the British Electric Traction Co. After about six years in practice as a consultant he went in 1911 to Brazil as engineer to the City of Santos Improvements Co. During the 1914-18 war he was in the Shipyard Labour Department of the Admiralty, and from 1919 to 1928 carried out private consulting work. He joined the London Power Co. in 1928 as technical press officer and retired from that position in 1939.

The late Mr. H. M. Sayers

Mr. Sayers, who had been a member of the I.E.E. since 1886, was the author of "Electricity Costs and Charges," "Brakes for Tramway Cars" and "Economic Principles of Electrical Distribution." He contributed numerous articles to the *Electrical Review* and other technical journals, and papers to the proceedings of the I.E.E.

Mr. J. S. Nodes.— The death occurred on 22nd December at the age of forty-one of Mr. John Stanley Nodes, chief accountant of the East Midlands Electricity Board and formerly district accountant with the Central Electricity Board (Central England Area).

Water Softening

THE cause of hardness in water and its determination, the methods of softening water and the disadvantages of hard and soft water are dealt with in the recently published report of the Water Softening Sub-Committee of the Central Advisory Water Committee of the Ministry of Health (H.M. Stationery Office, 1s 6d).

Apart from references to health and washing, some notes are given on the wastage of fuel due to scale formation and the effect of scale on the useful lives of water heating appliances. It is considered that the average wastage of solid fuel and electricity in the case of kettles is about 10 per cent, and while with immersion heaters there is no wastage at all the element may burn out due to excessive scaling. Damage to appliances, however, is caused not so much by the scale as by unskilled efforts to remove it.

In a section which is concerned with industry and the softening of public water supplies the opinion is expressed that with some exceptions central water softening is unlikely to benefit productive industry. The final section deals comprehensively with the softening processes and the cost of operating each kind of system, including centralized waterworks plant. It is suggested that if a general policy of water softening is adopted it must be before and not after distribution, although the use of domestic softeners is not deprecated.

Overseas Electrical Trade

Further Decline in Exports in November

WHETHER attributable to the decline of the "sellers'" market or to other causes, exports of electrical goods and machinery from the United Kingdom during November again showed a decline compared with the previous month, despite the fact that exports generally advanced. The total, £9,965,513, compares with £10,046,755 in October and £9,667,644 in November, 1948, and is £1,451,939 lower than the record January figure.

Although electrical exports as a whole in November were higher than in the corresponding month last year, shipments of electrical goods and apparatus (excluding machinery) were actually lower, £6,244,727 as against £6,681,031. The diminished purchases by South Africa (£539,477 compared with £994,452) were to some extent responsible for this, but several other countries bought considerably less, including India, £520,449 (compared with £668,996); Syria, £7,855 (£52,916); Egypt, £129,866 (£223,363); China, £2,128 (£27,570); Mexico, £7,446 (£37,092); and Brazil, £30,448 (£69,509).

Among the more promising markets were Australia, which increased its purchases from £767,870 to £1,051,530. New Zealand (from £246,078 to £307,228), Malaya (from £172,337 to £263,292), Canada (from £50,353 to £105,031), Poland (from £47,105 to £112,699), Austria (from (£21,138 to £52,778), Greece (from £26,875 to £76,514), Turkey (from £46,085 to £84,966), Palestine (from £5,423 to £33,873) and Argentina (from £180,998 to £247,795).

No less than £1,466,953 worth of tele-

TABLE 1.—ELECTRICAL EXPORTS

Class	Nov. 1949	Nov. 1948	Class	Nov. 1949	Nov. 1948
	£	£		£	£
Telegraph and telephone wires and cables (submarine) ...	117,625	45,720	Parts and accessories of cooking and heating appliances ...	35,768	30,057
Ditto, not submarine	628,782	738,094	Flat irons	29,834	35,605
Wires and cables, rubber insulated	270,222	489,210	Commercial electrical instruments	101,902	100,880
Ditto, cotton, silk or artificial silk insulated	37,830	64,526	House service meters	80,888	188,048
Ditto, enamel, glass or asbestos insulated	56,188	37,093	Time recorders and time switches	12,159	9,723
Ditto, paper insulated	623,258	772,188	Other electrical instruments ...	112,584	68,356
Ditto, other	104,531	88,519	Electro-medical apparatus (not X-ray)	39,465	38,818
Commercial radio apparatus ...	203,465	236,580	X-ray apparatus, tubes and parts	38,256	72,757
Domestic radio apparatus ...	181,364	269,187	Permanent magnets	22,282	16,764
Telegraph, telephone and signalling apparatus	1,466,953	1,147,644	Insulating cloth and tape ...	83,697	88,434
Radio loudspeakers	23,488	35,030	Other insulating materials ...	79,106	122,419
Sound reproducing apparatus components and parts, other than cinematograph apparatus	238,595	214,629	Unclassified goods and apparatus	336,896	381,128
Other radio, etc., apparatus ...	61,429	48,148	Generators, up to 200 kW ...	646,273	372,650
Radio valves	121,970	142,295	Ditto, over 200 kW	337,523	135,212
Electric lighting carbons ...	18,431	16,018	Ditto, parts	142,733	85,302
Lamps, not exceeding 24 V ...	32,578	19,577	Motors, railway and tramway ...	15,785	7,886
Discharge lamps	31,113	42,228	Ditto, others, up to ½ h.p. ...	61,989	143,749
Other lamps	52,541	78,038	Ditto, from ½ to 1 h.p.	25,047	72,449
Other lighting apparatus ...	311,329	441,744	Ditto, from 1 to 250 h.p. ...	396,672	538,420
Primary batteries	112,898	97,278	Ditto, over 250 h.p.	31,952	40,099
Accumulators for motor vehicles	176,428	138,643	Ditto, parts	69,065	46,474
Ditto, traction	28,382	16,200	Converting machinery	7,021	8,688
Ditto, radio	3,321	3,915	Transformers, including coils ...	588,349	359,886
Other portable accumulators ...	105,472	66,136	Rectifiers for power house use ...	56,639	35,519
All other accumulators	50,281	27,286	Motor starting and control gear...	183,405	150,341
Parts and accessories	89,412	47,881	Switchgear and switchboards (not telegraph or telephone) ...	799,973	710,519
Cooking appliances	73,837	146,439	Other electrical machinery ...	36,697	31,944
Heating appliances	50,167	57,802	Vacuum cleaners and parts ...	168,504	144,510
			Other electrically operated portable appliances	153,159	102,965
			Total	9,965,513	9,667,644

graph, telephone and signalling apparatus was disposed of, Australia taking £460,452 worth. Another bright spot in the market was accumulators, sales of which increased from £252,174 to £363,884: South Africa continues to be a good customer (£91,586). Apart from motors and convertors, exports of which fell respectively from £849,077 to £600,510, and from £8,688 to £7,021, all types of electrical machinery showed improved business compared with November last year. Overseas sales of generators were particularly good, the total at £1,126,529 being almost double that for the corresponding month of 1948. The improvement was contributed to by all sizes of machine.

Russia was once more the biggest customer (£304,001), but Australia accounted for £227,976 worth, over £200,000 more than in November, 1948. South Africa (£327,641), India (£309,642) and Australia (£140,327) were the recipients of a substantial portion of the £1,672,084 worth of "other electrical machinery" sold.

Imports of electrical goods and machinery at £435,871 were £27,061 more than in October and £127,293 higher than in November, 1948. The largest suppliers of electrical goods and apparatus were the United States (£86,608), the Netherlands (£75,966) and Canada (£39,780).

TABLE II.—DISTRIBUTION OF ELECTRICAL GOODS AND APPARATUS

Destination	Nov. 1949	Nov. 1948
	£	£
Channel Islands	32,177	50,937
Malta and Gozo	74,754	51,361
Cyprus	17,459	17,452
British West Africa	77,547	76,270
Union of South Africa	539,477	994,452
Northern Rhodesia	31,702	22,782
Southern Rhodesia	158,784	99,300
British East Africa	119,610	133,552
Bahrein, Koweit, Qatar and Trucial Oman...	23,600	56,066
India	520,449	668,996
Pakistan	154,762	143,493
Malaya	263,292	172,337
Ceylon	57,528	94,000
Hong Kong	120,997	89,717
Australia	1,051,530	767,870
New Zealand	307,228	246,078
Canada	105,031	50,353
British West Indies	98,962	101,800
Anglo-Egyptian Sudan ...	26,477	17,652
Other British Countries ...	57,051	63,615
Irish Republic	210,176	267,951
Soviet Union	26,114	84,425
Finland	31,214	40,567
Sweden	112,261	221,346
Norway	145,499	128,063
Iceland	19,582	29,975
Denmark...	100,549	93,360
Poland	112,699	47,105
Germany	12,833	29,540
Netherlands	129,928	186,598
Belgium	83,371	110,620
France	48,150	26,072
Switzerland	49,437	33,443
Portugal	19,145	84,192
Spain	20,321	53,512
Austria	52,778	21,138
Hungary	12,850	14,534
Czechoslovakia	22,432	16,876
Yugoslavia	1,649	5,092
Greece	76,514	26,875
Turkey	84,966	46,085
Dutch East Indies	44,182	31,128
Dutch West India Islands ...	2,706	5,094
Portuguese East India ...	14,553	46,232
Syria	7,855	52,916
Lebanon	25,182	29,433
Palestine	33,873	5,423
Egypt	129,866	223,363
Iraq	65,346	74,163
Iran	152,207	139,573
Burma	36,916	21,361
China	2,128	27,570
United States of America ...	19,038	18,303
Mexico	7,446	37,092
Colombia...	10,728	10,226
Venezuela	29,633	76,034
Chile	11,442	18,536
Brazil	30,448	69,509
Uruguay	10,421	8,788
Argentine Republic	247,795	180,998
Other Foreign Countries ...	151,187	119,827
Total	6,244,727	6,681,031

Earthing Resistance

ANOTHER way of reducing the resistance-to-ground at earthing points is announced by Mr. Ivar H. Sanick, a consulting chemist, of Stockholm. Field tests conducted by the Swedish State Board of Power in co-operation with the Institute of High Tension Research in Uppsala and also by the Royal Board of Swedish Telegraphs are said to have been quite promising in chemical respects.

The principle consists in forming a semi-permeable conducting gel at the electrode-to-soil contact. The suggested gel consists of a complex compound which is substantially water insoluble and retains its properties of electrical conductivity without deterioration over long periods of time. Its conductivity is claimed by Mr. Sanick to be substantially unaffected by leaching in rain or ground water.

The advantage of a gel over in-soil-precipitated salts in the form of crystals or amorphous substances is that the gel is a homogenous mass with only one large contacting surface, instead of an enormous number of crystal contacts.

The gel is formed in the ground by injecting with a pressure pump two solutions through a hollow grounding rod, or simply poured on the soil.

National Supply Survey

ELECTRICAL ASSESSMENT OF THE FOURTEEN AREAS

9—SOUTH EAST SCOTLAND AREA

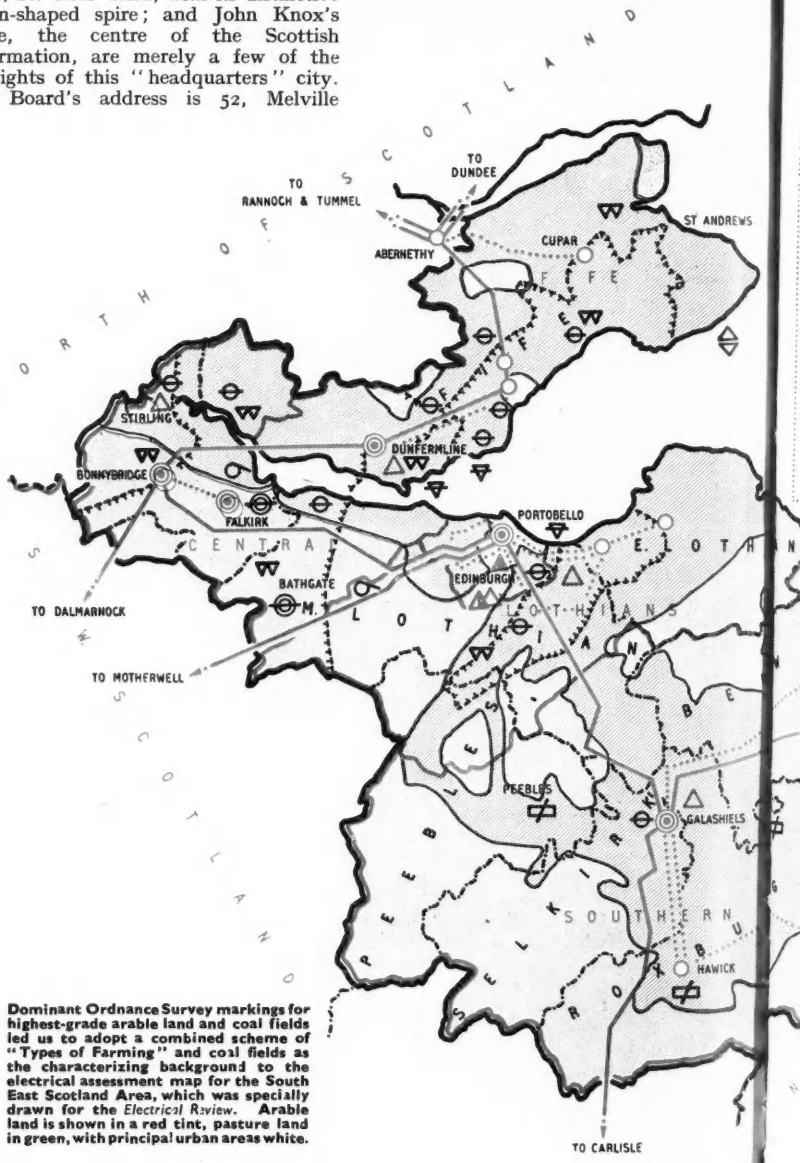
WHILE it is not a purpose of this survey to describe the new area electrical organizations as such, the Board and the Division are the two primary electrical features of the Area which it is now our task to assess electrically. An outline picture of the two authorities is therefore presented by means of the accompanying organization trees which should be read in conjunction with appropriate features on the specially prepared electrical assessment map of the Area. We also publish photographs of the principals and the leading officials of the Board and Division.

The South East Scotland Electricity Board executive team comprises Sir Norman Duke, Chairman; Mr. W. S. Sawtell, Deputy Chairman; Mr. T. R. Warren, Chief Engineer; Mr. J. W. Moule, Chief Commercial Officer; Mr. E. Maxwell, Chief Accountant; Mr. T. J. Mullan, Secretary; and Mr. E. W. Churchward, Purchasing Officer. The Division executive team also has seven members as follows: Mr. J. F. Field, Divisional Controller; Mr. G. Gunn, Generation Engineer (Operation); Mr. J. Hagen, Generating Engineer (Construction); Mr. G. S. Wilton, Transmission Engineer; Mr. J. Cockburn, Divisional Accountant; and Mr. G. A. Gordon, Divisional Secretary.

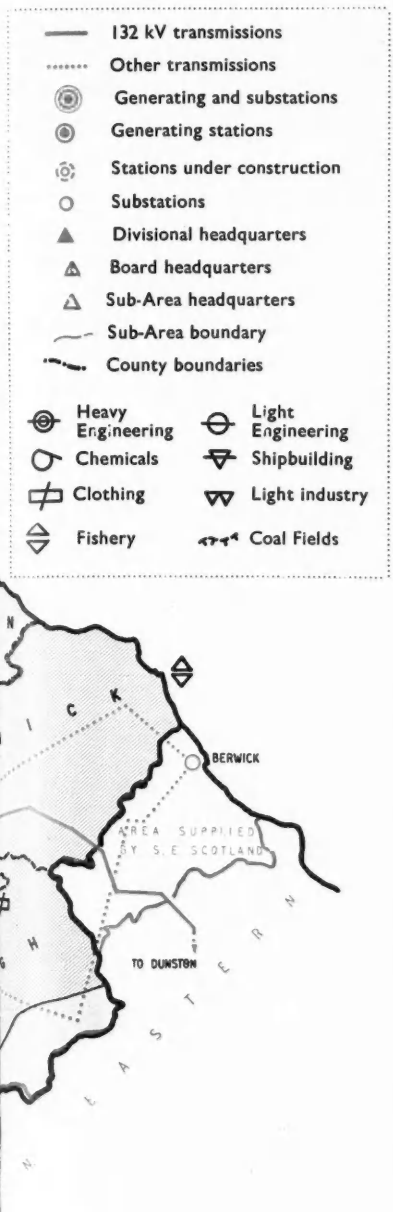
Both the Board and the Division have their headquarters in Edinburgh, the capital, whose romantic associations probably outnumber those of any other city in the British Isles. Princes Street and its adjacent sunken gardens, with the Scott Monument, near the site of the old Nor' Loch, all dominated by the Castle, make a magnificent setting for the "New Town," which is gracefully laid out on symmetrical Georgian lines in smooth grey stone. Holyrood Palace, early sixteenth century, is built near the remains of the eleventh century Holyrood Abbey. The Palace, which was created by James

Princes Street, Edinburgh, the subject of the title picture, is one of Europe's most celebrated thoroughfares. The Scott Monument is prominent and on the heights behind is Edinburgh Castle. (*Scotsman* Photo)

IV as a Royal residence, and became the scene of many romantic incidents, particularly in the reign of Mary, Queen of Scots; St. Giles' Kirk, with its distinctive crown-shaped spire; and John Knox's house, the centre of the Scottish Reformation, are merely a few of the highlights of this "headquarters" city. The Board's address is 52, Melville Street, Edinburgh, 3, while that of the Division is, temporarily, 1, Dewar Place, Edinburgh, 3.



Dominant Ordnance Survey markings for highest-grade arable land and coal fields led us to adopt a combined scheme of "Types of Farming" and coal fields as the characterizing background to the electrical assessment map for the South East Scotland Area, which was specially drawn for the *Electrical Review*. Arable land is shown in a red tint, pasture land in green, with principal urban areas white.



The South East Scotland Area may be reasonably described as based largely on the River Tweed and the Border hills, the Cheviots, which rise to 2,600ft, but do not challenge the beetling crags and precipices of the Highlands. Little remains now of the castle at Berwick-on-Tweed, but the whole town is still surrounded by the old walls and earthworks, a reminder of the signing by King Charles of the ignominious "Pacification of Berwick" during the events which led to the Civil War.

The South East Scotland Area is the second smallest of the fourteen, with a total of 3,312 sq miles, which includes 152 sq miles of the North Eastern Area by arrangement with the North Eastern Electricity Board. By way of purely survey assessment values there is much of interest in some comparisons and contrasts with other Areas; in presenting the following figures we are not in any way influenced by any other consideration. The respective coverages of this, the South East Scotland area; the smallest of the Areas, London; and the largest, the Eastern Area, are 3,312, 257 and 7,870 sq miles. The populations are 1.37 million, 6.27 million and 4.7 million, respectively. The consumers are 0.29 million, 1.51 million and 1.18 million, respectively, and the kWh sold figures for the year 1947 are 724 million, 3,320 million and 2,925 million.

In the article dealing with the South West Scotland Area we explained, by reference to the special map published in the *Electrical Review* of 3rd June, last, that the new South West Scotland and South East Scotland Areas combined correspond to the former Central and South Scotland Areas of the C.E.B., except for a strip of land averaging about 12 miles wide and embracing Abernethy and Dundee, immediately north of the South East Scotland Area, which strip is now vested in the North of Scotland Hydro-Electric Board. This is technically correct, but it does not take into account the 152 sq miles of the North Eastern Electricity Board's official Area at present supplied by the South East Scotland Electricity Board. In 1947 the electricity generated in the former Central and South Scotland Areas combined was 3,349 million kWh, and with the contract purchases from the former Grampian

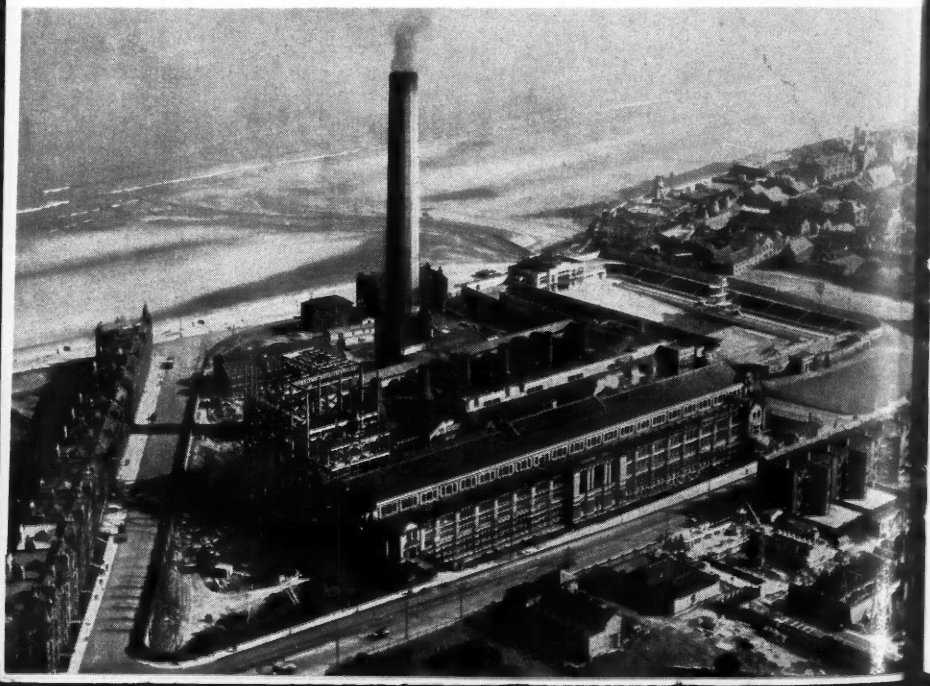
Electricity Supply Co., Ltd., the total "generation equivalent" figure was 3,417 million kWh. Electricity exported from the combined areas was 169 million kWh, and that imported amounted to 141 million kWh.

The kWh imported into the new South East Scotland Area during the year ended 31st March last was 189.6 million, while the kWh exported from the Area in the same period was 119.1 million. During the same time 842 million kWh was generated by the Division's five generating stations, which have a total plant installed capacity of 221.1 MW and a total effective capacity of 202.0 MW. They are all steam stations and are all operated on a winter three-shift basis. The largest of these stations, with installed and effective capacities of 132.5 MW and 117.0 MW, respectively, is Portobello which was previously owned by the Edinburgh Corporation and is situated at Portobello at the extreme east of Edinburgh on the south bank of the Firth of Forth, where a little further east this coastline provides some of the finest golf links in Scotland. The same vicinity provided some of the famous battlefields; for instance, Prestonpans where "Bonnie Prince Charlie" gained his famous victory; Carberry, near Inveresk, where Mary, Queen of Scots surrendered to the Scottish Confederate Lords; and Pinkie, where the Scots suffered one of their worst defeats by the English led by the Earl of Somerset.

The second largest power station, Bonnybridge, previously owned by the Scottish Central Electric Power Co., and situated at Bonnybridge in the South of Stirlingshire, has an effective capacity. With installed and effective plant capacities both of 10.0 MW, the third in order of size is Townhill, formerly of the Fife Electric Power Co., and situated at Dunfermline the ancient residence of Kings of Scotland in the County of Fife. A splendid panoramic view of the shores of this beautiful county can be obtained from Edinburgh Castle. The county also embraces the university town of St Andrews which boasts the most famous golf course in the world.

The station, formerly owned by Falkirk Corporation, has plant and effective capacities of 7.5 MW and 6.0 MW, respectively. Falkirk is also in Stirling County, a few miles east of Bonnybridge and almost due south of Stirling town, the scene of famous exploits of William Wallace and Robert the Bruce. It has been said that "whoever held Stirling

The largest of the generating stations—Portobello—is to have the largest capacity boiler in Europe



On the shores of Fifeshire is the town of St. Andrews, renowned for its University and golf course

controlled Scotland." The fifth station in the area is Netherdale, which belonged to the Scottish Southern Electric Supply Co. It has a plant capacity of 7.1 MW, an effective capacity of 5.0 MW, and is situated in the town of Galashiels. There are no new power stations in course of construction in the Area, but a major 60 MW extension at the Portobello power station, which is scheduled to be completed next year, has some special features.

The boiler for this extension has three drums installed 130 ft above ground level and weighing 30, 40 and 50 tons, respectively, which were made in Derby from special steel ingots. It is claimed that the boiler will have a greater output than any other boiler in Europe. The coal consumption will be 1 lb per kWh, as against 1.6 lb per kWh by the present plant in the station, and this will result in a reduction in consumption of 90,000 tons of coal per year, and a monetary saving of £225,000.

The major (grid) transmission system in the area is a simple one, with switch substations at Portobello (150 MVA when completed), Bonnybridge (40 MVA), Galashiels (40 MVA), Redhouse (30 MVA), Dunfermline (20 MVA), and Kirkcaldy (20 MVA). The transmission line embracing all these substations runs from Abernethy (Perthshire) through Redhouse, Kirkcaldy, Dunfermline, Bonnybridge, Portobello and Galashiels and terminates at Wooler in Northumberland.

In support of the following comprehensive load analysis for the five Sub-Areas and the Board Area, in which the figures in each column represent the percentages of the total load for the Sub-Area or the Board Area, we will first give

LOAD ANALYSIS

	Board Area	Sub-Areas				
		Edinburgh	Central	Fife	Lothians	Southern
Domestic	32.5	37.9	21.8	36.1	24.4	41.2
Commercial	12.7	13.9	11.5	14.1	6.6	15.7
Industrial	32.8	23.8	55.4	39.8	11.3	25.7
Mining and Quarrying	10.6	4.8	7.9	5.5	52.2	5.6
Agriculture	1.0	0.1	0.6	1.5	2.1	7.2
Schools, Hospitals and Public Buildings, etc.	2.4	2.7	2.0	1.9	2.2	3.4
Public Lighting	1.1	1.7	0.8	0.6	0.3	0.3
Traction	4.3	9.6	—	—	0.7	—
Others, unclassified	2.6	5.5	—	0.5	0.2	0.9

The figures in each column denote percentages of the total load for the Board Area or particular Sub-Area.

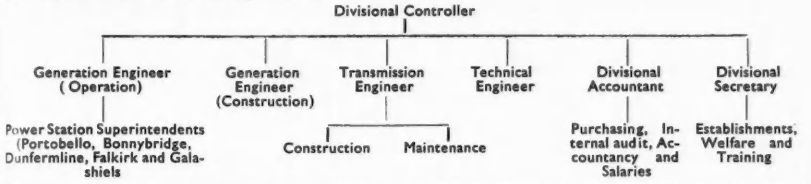
Sir Norman Duke, the chairman of the Board, and Mr. W. S. Sawtell, the deputy chairman

a few overall figures. The m.d. in kW for 1948/49 for the Board Area was 237,497, and the Sub-Areas' m.d.s in kW were: Edinburgh, 109,863; Central, 50,389; Fife, 42,454; Lothians, 19,481; and Southern 15,310. The electricity sold during the same period in the Board Area and Sub-Areas in the same order and in millions of kWh were 824.5, 368.8, 195.6, 136.9, 83.3 and 39.9.

One of the first questions asked in an investigation for a survey such as this is, where is the load? One might instead ask where are the people and where is the industry? The load analysis table answers two of these questions very well indeed for specified areas, but let us take a look at the maps to get more general impressions with regard to the area as a whole.

The Ordnance Survey "Types of Farming," "Land Utilization," and "Land Classification" maps all show dominant large areas of the highest class of arable land hugging both the north and south coasts of the Firth of Forth. Both of these areas run westwards and join to project well into Stirlingshire. The area north of the Forth covers practically the whole of Fifeshire. Another smaller area of arable land of the highest quality runs from the coast between Berwick and St. Abbs Head and roughly follows the Tweed to round about Melrose where the land is particularly fertile and admirably cultivated, though sparsely populated. The dearth of villages and towns and the prominent well-kept grey stone farmhouses are features of this land, the low-lying nature of which was demonstrated last year when the Tweed burst its banks and flooded hundreds of square miles and heavily damaged property, including

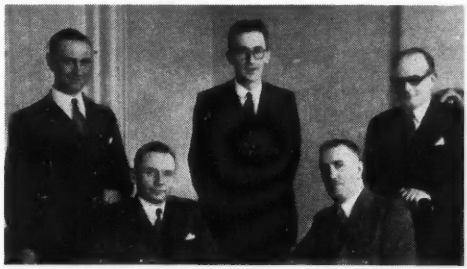
South East Scotland Division Organization



many bridges carrying the main line from Berwick to Dunbar, from which a splendid view of the famous Bass Rock, an isolated mass of basalt rising sheer out of the sea to a height of 350ft is obtained. From the same line Berwick Law, the strange volcanic hill near North Berwick, can also be seen.

On the "Coal and Iron" map are well marked, but not nearly so prominently, two coalfields in the Area. One field roughly follows the north coast of the Firth of Forth, underlying a considerable portion of the arable land of Fifeshire, but it is an extension from the greater field to the west, which reaches the other way well beyond Glasgow and to round about Stirling in the north and Carluke in the south. The other and much smaller coalfield presents a front on the south coast of the Firth of Forth east of Portobello for, say, ten miles, and runs inland south-west, narrowing off west to the Pentland Hills. These two dominant map markings, arable land and coalfields, gave a very good reason for the characteristic background of our special map.

Fifeshire has some of the finest iron and coal mines in Scotland and more of the largest grade of collieries (i.e., employing over 1,000 men) than has the greater area extending westward. There are two of the largest class of collieries in the Edinburgh field, but most of the mines there are much smaller. Referring to the collieries as a whole, the supplies range up to a consumption of 13 million kWh per annum for a single colliery. It is into the Fifeshire coalfield, near Inverkeithing, that one is carried when travelling north over the Forth Bridge built in 1890 and still, even by to-day's standards, a gigantic engineering achievement. Near here, too, stands the string of forts or defensive line built in the reign of Antoninus, the Roman emperor, to form a barrier between the Firth of Forth and the Clyde to keep the Picts out.



The executive team of the South East Scotland Electricity Board. Back row, left to right, Mr. J. W. Moule, Mr. E. Maxwell and Mr. E. W. Churchward. Front row, left to right, Mr. T. R. Warren and Mr. T. J. Mullan

The principal officers of the B.E.A. South East Scotland Electricity Division. Left to right, Messrs. G. S. Wilton, J. Hagen, G. G. Small, J. F. Field, J. Cockburn, G. Gunn and G. A. Gordon

Of the 8,833 farms of more than ten acres in the Board's Area, 1,223 were on supply at 31st March last. Corresponding figures for the Sub-Areas were: Edinburgh, 50 and 38; Central 1,786 and 193; Fife, 2,217 and 324; Lothians, 1,737 and 431; Southern 3,043 and 237. Some of the farms are responsible for quite high consumptions, the largest being about 120,000 kWh per annum.

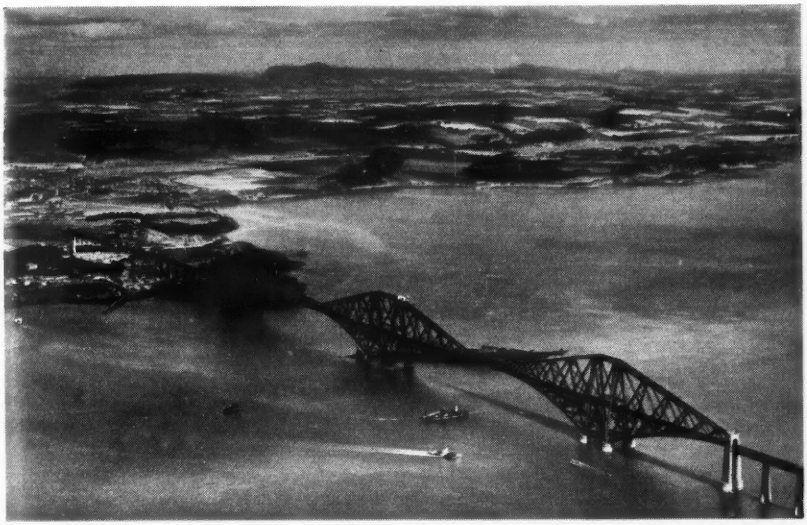
An industry more characteristic of the Area than others with far greater electricity consumption figures is weaving, which is prominent in the Scott country at the western end of the Tweed Valley, a wooded and hilly terrain which still retains much of the atmosphere of the old Border feuds, now softened by the quiet grey little Border towns like Galashiels, Melrose, Kelso and St. Boswells, some with notably beautiful churches. Abbotsford House, the home of Sir Walter Scott, looks across the Tweed to Boleside, and the building inspires a feeling of reverence for the great romantic genius who lived there for twenty years.

Before citing specific population and population density figures, let us take a brief glance at the "Population Density" map. Although extreme ends of the range are represented, there are not the dominating contrasts that we find in some Areas. There is a sizable patch of "dense urban" (over 25,000 per sq mile) at Edinburgh, and other markings of the same grade, little more than dots, are at a few places like St. Andrews, Dunfermline, Stirling and Hawick. In contrast, to the south of Edinburgh around Peebles, the Pentland Hills and Lammermuir Hills, there is the other extreme of "virtually uninhabited" land. And there is considerable representation of the suburban grade (400 to 6,400 per sq mile), but the dominant marking throughout the Area as a whole is "dense rural" (50 to 400 per sq mile).

The population of the Board Area is about 1.4 millions and the density per square mile is 415. Corresponding figures for the Sub-Areas are: Edinburgh, 491,000 and 9,093; Central, 303,000 and 775; Fife, 304,000 and 602; Lothians, 147,000 and 250; Southern, 129,000 and 73.

A word about consumers will impart fuller meaning to the load assessment picture we have tried to portray. At the end of March, 1949, there was a total

The Scott country at the west end of the Tweed valley is mellowed by little weaving towns like Kelso



The Forth Bridge is still, even when judged by to-day's standards, a gigantic engineering achievement

of 297,000 consumers in the Board's Area, representing a consumer density of 90 per sq mile. Corresponding figures for the Sub-Areas were: Edinburgh, 135,261 and 2,505; Central, 54,526 and 139; Fife, 63,112 and 125; Lothians, 26,674 and 45; Southern 17,447 and 10. The Board's largest consumer is an aluminium works which consumes over 36 million kWh per annum. From the purely commercial point of view we could say that the National Coal Board is the largest single consumer, but that would lead to confusion unless we dealt with other consumers in industrial groups, and in any case these selected individual consumers are cited with the load analysis table in mind.

We will think in terms of single collieries, then, of which there are a large number, and even so, the largest colliery supply ties with a dyestuffs and chemicals factory, with a consumption of 13 million kWh per annum.

Other selected single large consumers in the Area and their consumptions in kWh per year are: a steel foundry, 6 million; a steel wire manufactory, 4 million; a flour mill, 4 million; docks, 18 million; a brick works, 6 million; a linoleum factory, 4 million; a distillery, 1.5 million; and a paper factory, 2.5 million.

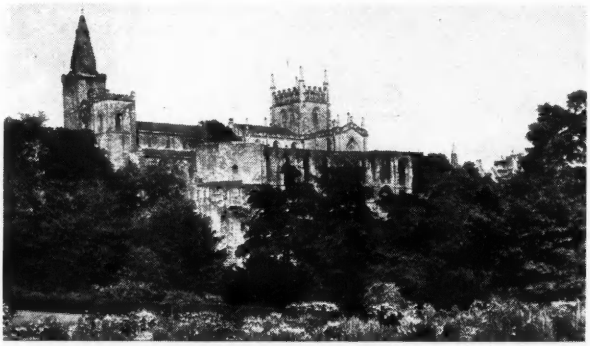
An outline picture of the tariff position must be included if the electrical assessment is to be reasonably representative in other respects. Perhaps because of the lack of dominant contrasts to which we have already referred, there does not appear to be the same great diversity or complexity, and, indeed, confusion, with regard to tariffs in this Area that we have found in some of the others we have dealt with.

The charges at present in force are generally those offered by the former undertakings, except that unit rates which were lower than 0.75d have since been raised to that figure. Generally the domestic consumer has the choice of a kWh flat rate of about 4.5d per kWh and a two-part tariff with the fixed charge based on the size of the dwelling, e.g., 15s per annum per habitable room plus 0.75d per kWh.

Commercial consumers in the Area are similarly treated, except that the fixed charges are based on the consumers' m.d.s or the electrical capacities of their installations. There are special

tariffs for large industrial consumers, farms and "off-peak" supplies in most parts of the area.

Service facilities afford by no means the least interest in the investigation, and a fairly reasonable assessment of these is given by the number and locations of the showrooms and service centres. In Sub-Area order they are as follows: *Edinburgh,* Edinburgh City; *Central,* Falkirk and Stirling; *Fife,* Anstruther, Cupar, Dunfermline, Kirkcaldy, Leven, Lochgelly and St. Andrews; *Lothians,* Dalkeith, Dunbar, Haddington, Musselburgh, North Berwick, Penicuik and West Calder; *Southern,* Berwick-on-Tweed, Galashiels, Hawick and Jedburgh. The Leven, Dunbar and Stirling Centres will be opened shortly.



Dunfermline, the ancient residence of Kings of Scotland, has one of the South East Scotland Division power stations—and a very beautiful abbey

The foregoing as a whole represents the result of our attempt to portray the electrical position in this particular Area as it was at, or as near as possible to, vesting day. And with one exception the development work represented by our story is bound up with the activities of the following pre-nationalization electricity supply undertakings which, again for convenience, we set out in Sub-Area order:—

Edinburgh, Edinburgh Corporation; *Central,* Borrowstounness Corporation, Denny and Dunipace Corporation, Falkirk Corporation, Stirling Corporation, Scottish Central Electric Power Co., Scottish Midlands Electricity Supply, Ltd., and West Lothian County Council (Broxburn and Uphall); *Fife,* Fife Electric Power Co., Kirkcaldy Corporation and the Electric Supply Corporation, Ltd. (St. Andrews); *Lothians,* Lothians Electric Power Co., Musselburgh and District Electric Light & Traction Co., Ltd., and North Berwick Corporation; *Southern,* Urban Electric Supply Co., Ltd. (Hawick), and Scottish Southern Electric Supply Co., Ltd. The only non-statutory undertaking in the area was that serving the small village of Reston in Berwickshire, which has since been vested in the Board. The exception we referred to earlier is the major (grid) transmission for which, of course, the former C.E.B. was directly responsible.

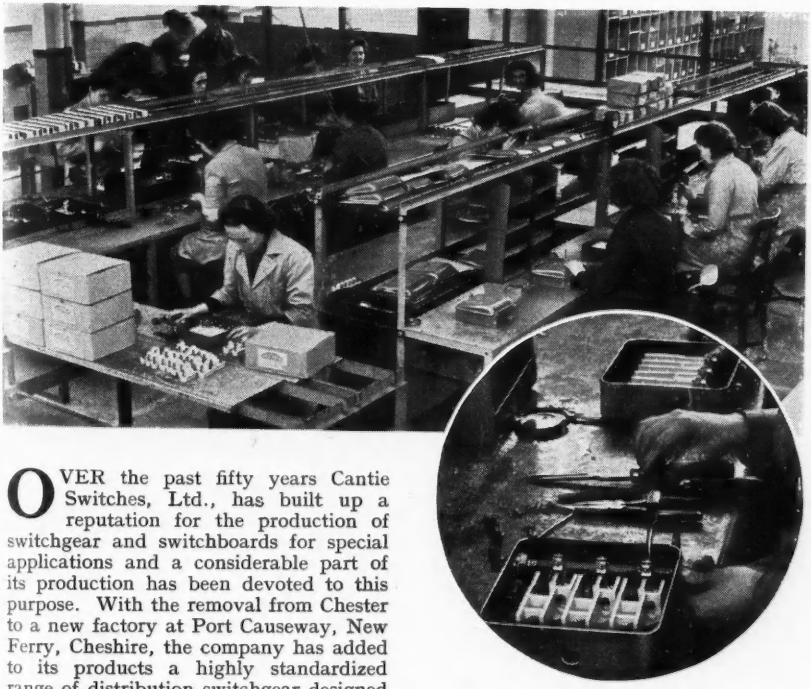
We have repeatedly stressed the fact that our survey is not concerned with organizations purely as such nor with their activities. All the same, a picture of the present without the future prospects has not a full meaning. Negotiations are in hand with the National Coal Board for several large colliery public supplies which at present are provided from the "private generation" stations of the N.C.B. A new satellite town is to be built at Glenrothes in Fifeshire, in a new colliery development area, and it is anticipated that considerable light industry will be attracted to the area. It is expected that the new town will have a population of about 30,000 and it will be designed to accommodate about 3,500 miners.

Negotiations are in hand for additional electric furnace load in the Central Sub-Area and the Board has under consideration extensive schemes for rural development, particularly in the Southern Sub-Area.

We are indebted to Sir Norman Duke and Mr. J. F. Field, and to their principal officers, for co-operation in the investigation which has led to the publication of this article.

New Switchgear Factory

Cantie Switches, Ltd., Enter Competitive Field



Two of the assembly lines where the new "normal duty" switch-fuses are made, and (inset) positioning the switch blades of switch-fuse units

OVER the past fifty years Cantie Switches, Ltd., has built up a reputation for the production of switchgear and switchboards for special applications and a considerable part of its production has been devoted to this purpose. With the removal from Chester to a new factory at Port Causeway, New Ferry, Cheshire, the company has added to its products a highly standardized range of distribution switchgear designed to meet the demand for reliable yet lower-priced equipment suitable for normal factory installations.

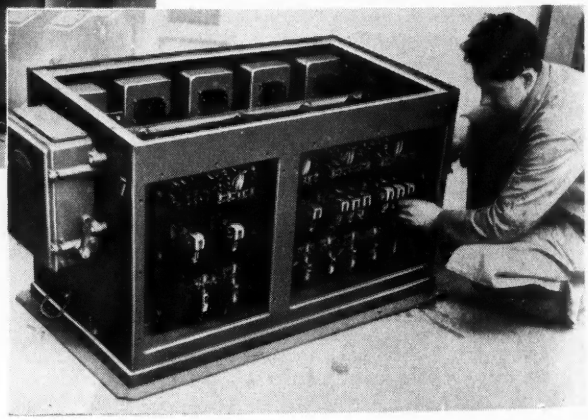
To achieve this standardization the company's design staff has been considerably expanded and the first-fruits of its work have been the development of a range of ND (normal duty) switches and switch fuses which are now just coming into production. Enclosed in robust metal-clad cases finished in grey enamel, these are specially designed with an eye to easy wiring, the switch bar being removable by undoing a single screw. Either rewirable or h.r.c. fuses with interchangeable carriers, which can be supplied for single-pole, double-pole, triple-pole or triple-pole-and-neutral connections, can be incorporated. The gear is available in 15 A, 30 A, 60 A and 100 A sizes, all for 500 V. It has been tested by the National Physical Laboratory and complies with B.S. Specifications. Future developments include a greater standardization of unit-type switchboards, and it is also probable that the company will enter certain new fields. while the porcelain fuse bases have been adopted for the assembly of new apparatus, which is carried out in five

main operations. The beginning of the assembly lines abuts the stores, the components being fed straight out on to them. The first operation is the making up of the switch mechanism. This is then fitted to the handle and operating shaft. Meanwhile the porcelain fuse bases have been assembled and the screw holes filled up with wax. With the switch mechanism, these are then inserted in the case and the switch blades are positioned. After the lid is fitted, the completed unit receives a final inspection and electrical test, the fuse bridges are inserted with their asbestos shields, and the whole is immediately packed in cartons ready for despatch. The provision shortly of a compressed-air plant will speed up screw-driving and similar operations.

The new factory, where these new switches are being constructed, has a floor area of 30,000 sq ft (all on one floor), about double that of the old works at Chester, and provides employment for about 200, many of whom are brought from Chester by private buses. Plans are already in hand to extend the factory floor space by 50 per cent by adding further bays at one side, the existing office accommodation being designed with this end in view. Additional land is available for further extensions.

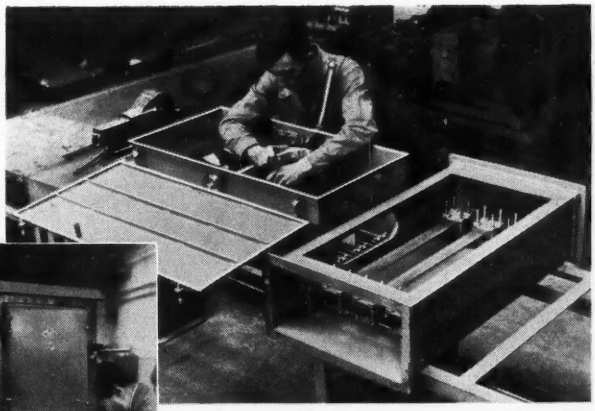
Roughly two-thirds of the factory as it is to-day is occupied by the machine shop, tool room, stores and assembly department for the smaller switches (up to 200 A, 500 V). Practically all the presses, drilling machines, lathes and other machines installed are new and of particular interest are the special devices made on the premises for speeding up production of some of the components. The fitting of a hopper feed on a capstan lathe enables switch contacts to be drilled about three times as fast as by a previous method utilizing drill jigs, while novel machines produce copper spring contacts in one operation. Much handling between stores, machine shop, paint spraying department and assembly is saved by the use of trolleys containing racks holding about 150 castings. Rearrangement of the plant necessitated by the proposed extensions will be facilitated by the availability of an overhead busbar system and by the fact that all machines are individually driven.

(Above) Mains supply unit for foundry ordered by N. G. Bailey & Co., Ltd., for the International Harvester Co., Ltd.

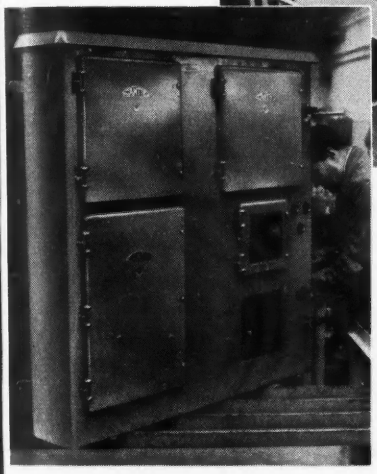


Power unit for airfield use

(Right) One of six 300 A 500 V unit-type boards for Cynamid Products, Ltd., Egypt, in the course of assembly



Distribution switchboard for a New Zealand power station



The other third of the factory, at the far end of the building and separated by a wall, is devoted to heavy-duty gear, unit-type switchboards and "specials," in capacities up to 500 A, 500 V, with switchboard up to 2,000 A. A large proportion of this equipment goes to power stations, gasworks, steel and chemical works.

A feature of the bulk of this equipment is the use of switch mechanisms of the Cantie bolt-lock type, which ensures rapid and positive operation in all conditions and which is vibration- and shock-proof. The mechanism consists fundamentally of an operating cam coupled by a shaft to the switch handle. Movement of the switch handle charges the main operating spring. When the spring is fully charged a locking bolt is withdrawn by a cam movement and the operating shaft carrying the switch blades is released. The shaft then operates independently of the switch handle. In this way no "dead-centre position" is possible and positive operations are obtained for both "on" and "off" movements. Handles can be arranged for locking in "on" or "off" positions.

Among many interesting contracts in hand when we visited the factory recently were sub-main distribution units for Buckingham Palace and the House of Commons; a power unit designed to provide five outgoing ways with separate push-button controls, for use on airfields in any climate; a mains supply unit for foundry use for the International Harvester Co., Ltd.; flush-mounted distribution switchboards of the cubicle type for the British Electricity Authority (the company claims to have been the first makers of this type of gear); 300 A, 500 V, unit-type boards, part of an order for sixty, for Cyanamid Products, Ltd., Egypt; several distribution switchboards for a New Zealand power station; galvanized units for the Anglo-Iranian Oil Co., Ltd.; switch-fuse units for building into machines, and also weatherproof types.

With the transfer of production to the new factory Mr. H. M. Goody, J.P., relinquished his position as joint managing director of the associated company of Brookhirst Switchgear, Ltd., to become managing director of Cantie Switches, Ltd. Our thanks are due to him and to Mr. P. J. Shipton, A.M.I.E.E., director and general manager of the company, for their assistance in preparing this article.

Electricity in India

Scope for Development

THE development and prospects of the electricity supply and manufacturing industries in India are reviewed by Mr. R. Owen, Senior United Kingdom Trade Commissioner in India, in his report on the economic and commercial conditions in India, published for the Board of Trade by H.M. Stationery Office at 4s net. The report, which is dated March, 1949, is the first since the partition.

Dealing with the generation side of the industry, Mr. Owen analyses the installed capacity of generating plant (public utilities only), the total for all India at 1st January, 1948, being 1,361,765 kW, of which 755,957 kW was steam operated, 97,679 diesel, and 508,129 hydro-electric. Plant installed per 1,000 population was 4.270 kW, and plant installed per square mile 1.116 kW. The total kWh generated in 1947 was 4,073.3 million, of which 1,733.9 million was steam generated, 144.8 million diesel and 2,194.5 million hydro-electric. Mr. Owen draws attention to the backwardness of electrical development in India and points out that, although the hydro-electric potential is 30-40 million kW, the installed capacity is only 0.5 million kW and consumption *per capita* 12 kWh. Broadly speaking, over half the output (53.4 per cent) of the Indian electricity supply industry is absorbed by Bombay, Calcutta, Kampur and Ahmedabad, which contain less than 1½ per cent of the population of the whole country. He considers that, if a real improvement is to be made in the standard of living of people in India by the use of electricity, rural development must be considered. Although such development might prove uneconomic, the indirect benefits accruing are of great significance. Referring to railway electrification, he says that in only a few zones in India to-day are there any prospects of finding an adequate return on new capital, and there can be little prospect of new projects obtaining support except as matters of operational necessity.

With regard to electricity supply administration, the Electricity (Supply) Bill of 1948 provides for the first time for the establishment of an authority in each province which can review the power resources of each region, study present and potential demands for power and arrange for an orderly supply of power capacity to match with the steady growth of power demands. Mr. Owen gives particulars of

Class	1946–47	1947–48	6 months ended September, 1948	Leading sources of imports in Col. (4)
	Lakhs of rupees			
Control and switchgear	116	179	124	United Kingdom U.S.A.
Generators, alternators and dynamos	94	157	107	United Kingdom U.S.A.
Motors	96	177	141	United Kingdom U.S.A.
Transformers	43	48	60	United Kingdom U.S.A.
Turbo-generating sets	22	39	22	U.S.A. United Kingdom Switzerland
Other electrical machinery	146	178	146	United Kingdom U.S.A.
Electric fans and parts	19	26	1	U.S.A. United Kingdom
Electric lamps and parts.				
Gas-filled	23	20	6	United Kingdom U.S.A. Netherlands
Vacuum	7	11	8	U.S.A. United Kingdom
Electric bulbs for torches	22	13	6	Hong Kong China
Electric lighting accessories and fittings	18	95	43	United Kingdom
Meters	28	76	52	United Kingdom
Electro-medical apparatus	14	31	14	U.S.A. United Kingdom

some of the major hydro-electric projects under consideration.

Turning to the manufacturing side of the industry, Mr. Owen states that manufacture has so far been on a comparatively small scale, mainly consisting of electric fans, the production of which in 1948 was 180,000, lamps and accessories (9,130,000), dry batteries and cells (123.1 million), power transformers up to 500 kVA (80,000 kVA) and electric motors up to 30 h.p. (60,000 h.p.). The Government of India has arranged with one British and one American company to prepare a report on a project for the setting up of a factory to manufacture heavy electrical plant with an anual capacity of 300,000 kW. It is expected that it will take five years for the factory to go into full production.

At present there are only two indigenous factories of any consequence producing in both cases only vulcanized rubber-insulated wires and flexibles and textile-insulated winding wires, and the output of these factories constitutes a small percentage of the country's requirements, whilst the principal raw materials have to be imported. At the time of this report the Government of India was expecting to conclude an agreement with a non-Indian manufacturer for the supply of technical assistance in the establishment of a new factory to manufacture telephone cables. (An agreement with Standard Telephones and Cables, Ltd., has now been announced and was reported in our issue of 9th December.)

United Kingdom manufacturers have always had a large share of the market for cables, and since the last war practically all the imports have been from the United Kingdom. Imports of electric wires and cables into the Indian Union for the six months ended September, 1948, were valued at 183 lakhs of rupees.

The values of imports of electrical machinery and apparatus into undivided India in 1946-47 and 1947-48, and the Indian Union in six months ended September, 1948, are shown in the table on the opposite page.

NEW BOOKS

Cathode Ray Tube Traces. By Hilary Moss, Ph.D. Pp. 66; figs. 52. *Electronic Engineering*, 28, Essex Street, London, W.C.2. Price 10s 6d.

This little book is a reprint of a series of articles published in *Electronic Engineering* between 1944 and 1946. The emphasis is placed on the geometrical interpretation of the pattern observed on the screen rather than on circuit details of ephemeral interest and some knowledge of the physics and technique of cathode ray oscillography is assumed.

The first chapter deals with the theory and production of Lissajou's figures, while the second considers sinusoidal time bases, and the third spiral and circular time bases. Chapter four discusses Fourier analysis and complex waves, while chapter five relates to amplitude modulated waves. There are three appendices which deal with series parallel two element networks, the use of the cathode ray tube and circuits for time bases. The book is copiously illustrated with unretouched photographs of patterns observed on the screens in addition to the many diagrams.

The book will be mainly of value to those concerned with the measurement of frequency and distortion in complex wave-forms. Engineers concerned mainly with pulsed systems will not find very much of interest to them, but the book has considerable general educational interest and Dr. Moss is to be congratulated on the hard work he must have put into making the photographs. It is a pity that there is no table of contents or index. It is to be hoped that a second edition will be called for in which Dr. Moss will be able to increase the space devoted to pulse techniques and also remedy the above defects.—A. H. B.

Industrial Electronics and Control. By R. G. Kloeffler. Pp. 478; figs. and index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 33s in U.K.

This volume attempts to cover the whole field of industrial electronic development, beginning with the basic conceptions of atomic structure and concluding with a reference to television. It is impossible to include in one volume either a complete survey of such a vast subject, or to go into detail on some of the major items. In common with allied textbooks covering the same field, there

is a tendency to labour the elementary sections and to expect the reader to follow the accelerated progress as the sections increase in difficulty. One might easily conclude that there is an inverse relationship between the complexity of the subject and the length of the explanation.

Although a wide field is covered there are still some well-known electronic devices which are conspicuous by their absence, e.g., the magnetron, Kipp relay, electronic counters and modern industrial electronic instruments. The eight-page chapter on a.c. theory is so short, so woefully incomplete, and so devoid of reference to electronic matters, that it could well be omitted. Finally, nearly all the commercial electronic equipment referred to is American; very little reference is made to progress elsewhere.

One of the best features of the book is the large number of very good illustrations. The author adopts a clear and simple style without recourse to mathematics or numerous symbols. In spite of the criticisms, this book can be thoroughly recommended to those who wish to get a general picture of the industrial electronic field, without going into too much detail. Some of its appeal, however, is lost because there are already numerous volumes on the same subject which are just as good.—R. S. M.

Permanent Magnets. By F. G. Spreadbury. Pp. 280; figs. and index. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 35s.

This is a very good general account of permanent magnets and their applications and is certainly a valuable introduction to the subject.

The description of permanent magnet materials (25 pp.) after a general introduction of 37 pp., seems rather too brief. One would expect, for example, to find some reference to such matters as cold-pressed powder magnets or ageing characteristics of specific widely used alloys. In addition, the performance figures quoted for both isotropic and anisotropic dispersion hardening materials are not up to date; considerable improvements have been made in the last few years.

The treatment of the theory of magnetism and of leakage is adequate, although one misses reference to recent work concerning powder magnets.

These researches make the essentials of permanent magnetism much easier to grasp than has been possible before; altogether the connection between theory of magnetism and permanent magnets is left too vague. The examples of applications are well chosen and the design principles quoted are quite satisfactory for this type of work. The chapters on instruments, magnetization and demagnetization are also very useful.

Apart from some very minor matters, the only remaining criticism is that no room has been found either in the theoretical or the practical part for any treatment of permanent magnets in structures carrying a.c. flux. It is felt that this seriously detracts from the general usefulness of the book, as this type of application is becoming increasingly important in many fields.—S. E. M.

Electronic Musical Instrument Manual. By Alan Douglas. Pp. 142; figs. 106, index. Sir Isaac Pitman & Sons, Ltd.

This book will interest those who are attracted by the science of sound. The author should succeed in convincing readers that present-day electronic musical instruments can be made to satisfy the most searching requirements.

The author starts with chapters on sound, music and noise and conventional multi-note instruments, followed by an excellent chapter on the production and mixing of electrical oscillations with particular reference to the requirements of the electronic instrument. A description of amplifiers and loudspeakers follows explaining the importance of natural sound reproduction.

The next chapter describes the most important commercial instruments, giving very full notes and circuits explaining their action. This is the most interesting part of the book and will be easily understood by those who have studied the preceding chapters carefully.

A concluding chapter on experimental methods contains suggestions for those who are particularly interested in development work connected with such instruments. The book as a whole demands a moderate level of technical knowledge only, as the circuits are fully explained from basic principles.—H. R.

Commerce and Industry

Technical Information Discussion Group

F.B.I. Register

FOR over two years now the Presentation of Technical Information Discussion Group, of which Professor R. O. Kapp is president, has been meeting at University College in London. It recently staged an exhibition in the Electrical Engineering Department to illustrate the many activities and interests of its members.

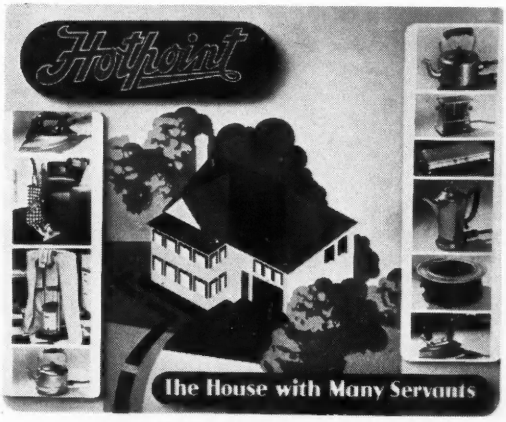
The exhibits included such electrical apparatus as that designed to demonstrate the properties of 3 cm electromagnetic waves (Professor Barlow) and that used in R.E.M.E. for teaching various methods of modulating, the principle of radar and radar automatic follow-up mechanisms (Major Jeffery); instructional films and film strips (Mr. Lockhart Smith); mechanical devices for helping the applied mathematician (Mr. Bainbridge Bell); charts and diagrams designed to present technical information in a readily assimilable form (Mrs. Neurath); examples of printing on Cellophane sheets for showing the structure of complex assemblies (Messrs. Chaplain & Nicholson); examples of new methods developed at the London School of Photo-Engraving (Mr. H. Smith) and many specimens of technical books and pamphlets prepared for special classes of readers. The exhibition formed the background of a conversazione which followed the Group's first annual general meeting.

Standardization of Cables

The Committee on the Standardization of Electrical Cables and Wires for Government Services (Secretary: Ministry of Supply, I.E.M.E., Walsingham, Chislehurst, Kent), has recently issued a 1949 edition of G.D.E.S. 18—polyvinyl chloride insulating and sheathing compounds for electric cables. The main difference from the 1945 edition is that the number of grades of compound has been reduced and that tests are now carried out on cable samples. Copies can be obtained from H.M. Stationery Office, price 1s 3d.

Hotpoint Window Display

In the accompanying picture we show an attractive new window display piece which the Hotpoint Electric Appliance Co., Ltd., has just produced. It is a three-dimensional display, the theme being that Hotpoint domestic appliances provide the modern home with many electrical servants. The display consists of a multi-coloured silk screen print on hardboard, with photographs mounted on either side of the house. The company is distributing the display to its various branches throughout the country and it is obtainable on loan by electricity showrooms and local electrical contractors for window display or for exhibition purposes.



New Hotpoint Electric Appliance window display unit

F.B.I. Register

The next edition of the F.B.I. Register will be published in January. This annual directory is a reliable reference for official organs responsible for promoting British trade overseas; at home it has

gained recognition as the only complete guide to the members of the Federation of British Industries, their products and services. The 1949/50 Register, published jointly by Kelly's Directories, Ltd., and Iliffe & Sons, Ltd., comprises over 1,000 pages and lists nearly 6,000 firms under 5,000 cross-reference headings. Sections include addresses giving complete information of all F.B.I. members and brands and trade marks, while the succinct information on firms and goods in a products and services section has strong interest and utility for overseas buyers. The advertising section provides an impressive shop window of British products and there are additional reference facilities in French and Spanish.

The Register is produced under an arrangement with the Federation of British Industries, and it is distributed to importers, buyers, trade commissioners, Chambers of Commerce, etc., all over the world. Home orders should be sent to Kelly's Directories, Ltd., 196, Strand, London, W.C.2, and overseas orders to Iliffe & Sons, Ltd., Dorset House, Stamford Street. London, S.E.1. The price is 42s, with special terms to F.B.I. members.

Maternity Home Installation

The former Queen Victoria Convalescent Home on the Clifton Downs above Bristol is at present in process of being converted into a maternity home. The building will be fitted with the Ardente/Winchester patient call, and staff location, radio rediffusion and therapeutic exercise systems. The installation, which will be the largest of its kind includes microphones, loudspeakers, and amplifiers with a total output of 120 W. Each floor will be self contained but capable of being paralleled for single operation such as relaying the chapel services, the chapel being fitted with microphones. The equipment and layout are the work of Ardente Acoustic Laboratories, Ltd., of Guildford, and the installation will be carried out by Wisehill Field & Co., Ltd., Andover, Hants.

Schoolboys' Exhibition

One of the big attractions at the Schoolboys' Own Exhibition which opens tomorrow at the Horticultural Halls, Westminster, S.W.1, will be "Electricity Arcade" arranged by the British Electrical Development Association. Three exhibits will deal directly with the generation of electricity. There will be a model illustrating the harnessing of the tides, and an animated model of a typical power station, accurately reproduced with coal-handling plant, boiler house and turbine hall. The big surprise in this example of the model makers' craft, occupying nearly half the area of Electricity Arcade, is when the entire end of the building sinks slowly down below ground level to reveal the illuminated interior with cut-away miniature steam turbines and other plant running at speed. The third item in the "Power" series, will be a hand-driven generator enabling a boy to experience the increase in effort required to satisfy an increase in demand for electricity.

Valve Data

To simplify some of the design problems associated with the use of thermionic valves in scientific instruments, to minimize servicing difficulties and to facilitate compliance with export conditions, the Electronics Section of the Scientific Instrument Manufacturers' Association has prepared a list of the preferred types. It is an endeavour to provide a working collection of a limited number of valve types on which new designs of instruments may be based.

The list was originally prepared for circulation among members of the Association, but as it was felt that other industries might be made aware of such a step with advantage it was brought up to date and printed. This 28-page booklet contains full information concerning the characteristics and base connection of 224 valves and is available from the Association at 17, Prince's Gate, London, S.W.7, post free.

Welding Research

The annual report of the British Welding Research Association, which has just been published, indicates that the year 1948/49 has been one of satisfactory progress. Three firms have withdrawn from membership and two from associate membership, but as 14 companies have joined the Association, membership now stands at 183 and associate membership at 11.

The general financial position has improved during the year, the income having been increased by £9,000, mainly as a result of Government contracts. This increase cannot be regarded as permanent, however, and a general expansion of income from industry is needed. By careful control of expenditure, a surplus of £4,000 has been realized and used to replenish part of the small reserve which was raided two years ago.

During the past year income has not been sufficient to expand the technical liaison services on the lines most advantageous to industry, but as a result of representing this handicap to the D.S.I.R. more favourable conditions of grant will be allowed for the period 1949/54. This means that if industry contributes £20,000 the Department will grant £20,000 and £100 for each additional

(*Continued on page* 1256)

FLUORESCENT LIGHTING

Some Recent Examples of Industrial and Commercial Applications

(1) Entrance hall, Workington Iron and Steel Co., Ltd. (Metropolitan-Vickers Electrical Co., Ltd.). (2) Department store, Thornton & Co., Ltd., Belfast. (British Thomson-Houston Co.)

(3) Coil winding shop. (Geo. Forrest & Son, Ltd.) (4) Knitted fabric department, Chilprufe, Ltd. (G.E.C.) (5) Weaving shed, Tootal, Broadhurst, Lee, Manchester. (Thorn Electrical Industries, Ltd.) (6) Library, W. H. Smith & Son, Ltd., Birmingham. (Siemens Electric Lamps & Supplies)

£100 of industrial income up to a maximum of £20,000 for the year. The effect should be to raise the Government grant by about £5,000, thereby permitting a much needed expansion of activities. Certain items of special equipment are also needed at the laboratories to allow the furtherance of particular projects.

Extraction and Fabrication of Aluminium

Although industrial use of aluminium is now second only to that of steel in volume, few people have any detailed knowledge of the processes of extraction and fabrication of the metal. In view of the scarcity of literature on the subject the Northern Aluminium Co., Ltd., Banbury, has brought out a 117-page book covering the various processes up to the time when the metal leaves its hands for final manufacture into finished products. Numerous excellent illustrations have been included and, though written primarily for readers with technical background, the text has been kept as non-technical as the subject will allow.

More Compensation Regulations

A draft has been laid before Parliament of the Electricity (Commissioners & Others) (Compensation) Regulations, 1950 (H.M. Stationery Office, 1d). These provide for compensation to the former Electricity Commissioners and the Central Electricity Board and their staffs for loss of employment or worsening of conditions.

Freight Charges

The British Transport Commission has published "Principles Proposed to be Embodied in a Charges Scheme for Merchandise Traffic," price 1s.

The pamphlet is intended for the information and convenience of trading bodies, and as a basis for discussions with them which the Commission desires to undertake early in the New Year. These draft principles cover all merchandise traffic conveyed by the Commission's services except coal, coke and patent fuel which will be dealt with later.

E.D.A. Sales Management Conference

The thirteenth annual E.D.A. Sales Management Conference will be held at the Caxton Hall, Westminster, S. W. 1, from 2nd to 5th May, inclusive. Provisional details of the papers to be read are as follows:—Tuesday: "Publicity for Load Building," by Mr. D. M. Oglivy (New York); "The Selection and Training of Sales Staffs," by Mr. J. A. Stedman (E.D.A.); Wednesday: "Selling Electricity to Industry," by Messrs. H. J. Gibson and F. C. Duffield; "Agricultural Electrical Equipment," by Mr. E. C. Claydon; Thursday: "Testing and Repairing Domestic Installations and Appliances in the Home"; "Lighting Developments and Economics," by Mr. J. A. Prowse (E.D.A.). On Friday morning there will be a general discussion, followed by the conference luncheon at the Connaught Rooms in Great Queen Street, W.C.2.

Contract Price Adjustment Formulæ

The following are the contract figures for use in the B.E.A.M.A. contract price adjustment formulæ: The rate of pay for adult male labour at 10th December is deemed to be 115s (unchanged). Cost of materials: The Board of Trade index figure for intermediate products as on 10th December is 269.1 and is the figure for November (against 266.0 for October).

Tinplate Workers' Travelling Scholarships

The Court of the Worshipful Company of Tinplate Workers have decided to grant not fewer than ten travelling scholarships, each to the value of £50, for the year 1950, on the same conditions as last year.

Jet Bomber Aircraft

The "Canberra" jet propelled bomber aircraft, the first to be produced in this country, was, as many readers will know, designed and constructed by the English Electric Co., Ltd. As the release of further information concerning this machine has been permitted by the Ministry of Supply, the company has published a technical brochure which illustrates and describes the bomber as fully as is possible at the present time.

Catalogues and Lists

Austin Taylor Electrical, Ltd., Windsor Works, Manchester Street, Oldham, Lancs.—Priced leaflet on busbar chambers of 100 A to 400 A capacity.

Siemens Electric Lamps & Supplies, Ltd., 38-39, Upper Thames Street, London, E.C.4.—Catalogue (No. Z.170) and price list of consumers' service units.

Benjamin Electric, Ltd., Brantwood Road, London, N.7.—Catalogue (No. 2500) of industrial lighting equipment and associated accessories.

Zenith Electric Co., Ltd., Zenith Works, Villiers Road, Willesden Green, London, N.W.2.—Catalogue and price list of automatic voltage regulators.

Fitzgibbon & Murray, Ltd., The Lower Mill, Kingston Road, Ewell, Surrey.—Catalogue of general lighting and bell accessories.

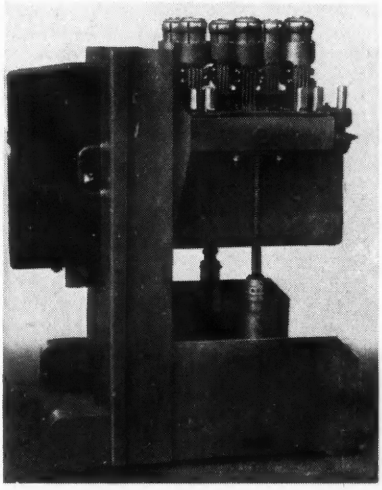
The Year's Progress

Further Details of Manufacturers' Work Completed in 1949

DURING the year under review transformer deliveries by the **Brush Electrical Engineering Co., Ltd.,** included three 7,500 kVA at 66 kV units for the Government of Bengal, two of 3,750 kVA at 60 kV 3-phase for a Danish cement mill, two 4,000 kVA impulse tested transformers for the Government of Travancore and a large number of 250 and 500 kVA units for the Bombay Electricity Supply & Tramway Co. Home deliveries included two of 20,000 kVA at 33 kV for Neath, and ten of 1,000 kVA for the Shell Marketing and Refining Co., in addition to over a hundred of 500 kVA for the B.E.A. Orders in hand include one 37,500 kVA generator transformer for the B.E.A., Warrington, two 30,000 kVA, 132 kV transformers with "on-load" tap-change gear for the B.E.A., Folkestone, four 10 MVA, 66 kV, units for the Midlands Electricity Board, and two 12.5 MVA, 33 kV, transformers for the East Midlands Board.

The Turbine Department has delivered an axial flow geared pass-out set for a cotton factory in Lancashire and the second of two 20,000 kW Ljungstrom sets to the B.E.A. at Lincoln. Orders in hand include a 2,500 kW gas turbine for the Metropolitan Water Board, a 30,000 kW Ljungstrom set for the B.E.A. at Warrington, several small Ljungstrom machines for cement works in India and Africa, besides axial-flow machines for sugar mills in Mauritius and Natal; also a 15,000 h.p. turbine for compressor driving required by the Ministry of Supply for gas turbine testing.

Besides h.r.c. fuse-switchgear, control gear for diesel-alternator sets has figured prominently; a switchboard of 46 panels for Petrocarbon, Ltd., includes vertical draw-out units of 100 MVA for 3.3 kV and 30 MVA l.v. units, all remote electrically controlled from a desk-type switchboard. For paper mills and similar heavy duty installations, a line of vertical draw-out units for 1,000, 2,000 and 3,000 A and 30 MVA has been produced. A truck-mounted 3,000 A oil-circuit breaker, with electrical operating mechanism, was another order of interest. Vertical draw-out units of 250 MVA for 6.6 and 11 kV are available with spring close or solenoid operating mechanisms. Now on the market is an 11 kV, 150 MVA oil switch-fuse designed for independent or transformer mounting and particularly suitable for ring-main duty.



Brush truck-mounted 3,000 A oil-circuit breaker fitted with electrical operating mechanism

Several 1,000 kVA, 6,000 V alternators for the North of Scotland Hydro-Electric Board and similar machines for Syria, Iceland, Argentina, Australia and India have been delivered. The 12,500 kW alternator for the gas turbine for Dundee is nearing completion.

Electrolytic generating sets have been delivered for use in India. Over two thousand 55 kW alternators have been despatched during the year to the order of the Russian Trade Delegation.

Deliveries of the new range of flame-

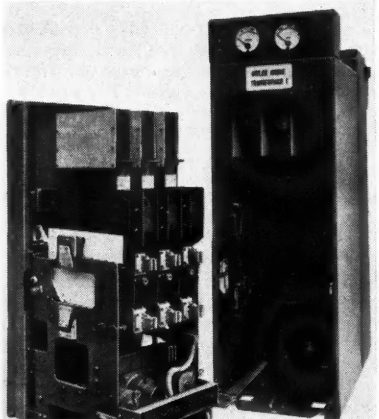
proof motors have been effected, and a further delivery of diesel-electric shunters for British Railways has been completed during the year. Orders in hand include machines for the Steel Company of Wales and power units for Spain.

Three new items were introduced by **A. Reyrolle & Co., Ltd.,** during the year; the construction of a new workshop with 14,400 sq ft of floorspace and a height of over 40 ft for the erection of the larger e.h.v. switchgear is well advanced; and a record output has been reflected in improved periods for delivery of standard equipment.

Small-oil-volume switchgear for from 33 to 132 kV continued in good demand. Part of the 66 kV air-blast gear comprising the first stage of equipment for a British Electricity Authority station was tested and made alive during the year. Other air-blast gear, of up to 3,500 MVA at 132 kV was also built and completion of the new workshop will soon enable the output of both air-blast and small-oil-volume switches to be increased substantially.

Numbers of 33 kV, 1,500 MVA bulk-oil-volume metalclad panels were produced for overseas and the 33 kV 500 MVA single-break outdoor single-tank circuit-breaker has established itself.

Standard horizontal-draw-out 3.3 to 33 kV metalclad switchgear (the range now goes up to 1,500 MVA with panel centres of 5 ft 3in) was in demand, a significant increase being noted for 22 kV switchgear from overseas.



Reyrolle metal enclosed 800 A circuit-breaker for controlling a 3.3 kV boiler house transformer

Production of 400 V and 3.3 kV air-break switchgear for power station auxiliaries was augmented and the range of vertically isolated oil-break switchgear was increased by the addition of a non-extensible indoor ring-main unit with two isolators and a tee-off circuit-breaker with ratings of 150 MVA at 6.6 kV and 250 MVA at 11 kV.

To coal-face flameproof equipments has been added type HGA6, which is a 3,300/110 V or 240 V 2 kVA main road lighting transformer panel. A specially equipped type GA1 contactor panel for the control of two motors driving a very long and heavy chain conveyor used in conjunction with coal ploughs was also developed and supplied.

Two notable orders covered nearly 900 gate-end and other panels of various types for eastern Europe. Some 6,600/3,300 V and 550 V transportable substations supplied to Canada were the first mining transformers equipped with integral circuit-breakers and flit-plugs for 6.6 kV to be manufactured by the company.

The sale of variable-speed a.c. commutator motors was maintained at the same level as for 1948, but there was some contraction in the market for induction motors and welding sets, the set-back being largely due to the import restrictions of overseas countries.

A number of true-sine-wave alternator sets for the accurate testing and calibration of meters were supplied during the year, one being for the National Physical Laboratory.

Profit from Trolley-buses

DURING the year ended 31st March last the South Shields Corporation's trolley-bus system made a net profit of £5,434, but the motor buses lost £14,904, resulting in a net deficit on the undertaking of £9,470. This was the first time the undertaking had made a loss in nine years. During the year the system carried 30 million passengers, an increase of more than two million on the preceding year. The South Shields Corporation now has 58 trolley-buses and 33 motor buses in service.

Pimlico District Heating

Battersea Power Station Back-Pressure Sets

THE most conspicuous feature at present of the blocks of flats being built by Westminster City Council in Pimlico to house 6,000 people is the heat accumulator shown in the accompanying illustration. Its dimensions are 126 by 29ft and its capacity 450,000 gal of water. Its function is to provide 6,500 therms a day for radiators. It will also heat tap water from the tower by means of a calorifier.

The source of heat is a couple of 1,350 kW back-pressure 3.3 kV turbo-alternators, which are being installed at Battersea power station for providing power for auxiliaries. Steam conditions are initially 600 lb/sq in and 800 deg F and at the exhaust 2 lb/sq in and 300 deg. The exhaust steam is condensed in a heat exchanger, giving up its latent heat to water which is taken across the Thames (about 700 yd) to the accumulator and returned therefrom by 12 in pipes. Live steam, reduced in pressure and temperature, is available as stand-by. Also the accumulator has several hours of storage capacity—enough to meet the heat demand if the turbines are out of action.

A thermostatically controlled valve in the return pipe will maintain the temperature of the water entering the accumulator at 200 deg F as a maximum; the leaving temperature will be 130 deg. In summer the flow temperature will be 160 deg and the return 90 deg. The return water (70,000 gal/hr max) will be pumped from the accumulator through drain coolers and heat exchangers in a closed cycle.

Kennedy and Donkin are the consulting engineers for the scheme.

Flats at Pimlico under construction with Battersea station in the rear

Australian News

AT Perth the hearing has begun of a claim for £577,430 brought by the Collie Power Co., against the Minister of Works and Electricity for loss suffered through the compulsory acquisition of the company's undertaking by the Western Australian Government in 1946. The case is proceeding.

Tramway Statistics.—Between 30th June, 1939, and the middle of 1947 the total mileage of electric tramways in Australia increased from 586 to 614. Gross revenue rose from £7,649,999 to £11,210,000, and working expenses from £6,089,000 to £9,495,000. Passengers carried increased from 695 million to 986 million (the peak year was 1944 when the passengers numbered 1,083 million). Net revenue in 1947 amounted to £1,715,000.

Battery Manufacture.—New companies registered recently include Varley Dry Accumulators (Australia), Ltd., manufacturers of batteries, cells, electrical devices, etc. The capital is £23,000.

Electricity Supply

Yorkshire Board's Task : Progress of Irish Schemes

COMMENTING on the task of the Yorkshire Electricity Board in the sphere of rural electrification, Mr. F. Newey, deputy chairman, describes it as "pretty formidable." He points out that on vesting day there were 393 villages and hamlets in the Board's area, which covers large parts of the West and East Riding, as well as a portion of North Lincolnshire, all without a supply of electricity. Of 18,650 farms of five acres and over, only 4,859 had electricity available.

The Board's five-year plan to connect all these villages will cost £1,068,000, based on present prices, and will involve the installation of 505 miles of high voltage and 233 miles of low voltage mains. This scheme will bring in some 13,000 new consumers, including 2,240 farms, and, in addition, the Board estimates that a further 1,300 farms will be linked up with the existing mains during this period. Signs of activity are to be seen already in Upper Wharfedale, where amenity as well as progress will be a first consideration. Following the announcement that cables will be placed underground in the picturesque village of Appletreewick, comes the news that Burnsall, farther up Wharfedale, will receive similar treatment. Every effort is being made by Mr. S. H. Lee, area planning officer, to see that poles are so routed as to interfere as little as possible with the natural beauty of the dale.

Sweden's Power Needs

Ordinarily an exporter of off-peak power to Denmark, Sweden has this year been forced to draw help from Danish thermal stations. It is hoped that the conditions of comparative shortage will be changed with the completion of several new plants in Sweden early next year. Compared with 148,000 kW of new installations in the present year, it is anticipated that 1950 will bring an addition of 265,000 kW, followed by a total increase of 610,000 kW in 1951 and 1952. The annual hydro-electric output is expected to be raised from 13,600 million kWh in 1948 to 20,600 million in 1953.

When extensions at the Harspranget station are completed in 1952 it will rank as the country's largest single water-power station, with a capacity of 291,000 kW. A new plant at Hjalta, on a tributary of the Angerman river, is now already operating at a third of its total ultimate capacity (180,000 kW); the same tributary will, by 1952, also drive a new 90,000 kW plant at Storfinnforsen. Expansion during 1950-52 will raise the capacity of the Holleforsen station (River Indal) to 126,000 kW, and this river will also yield 43,500 kW from a third set at the Stadsforsen plant and 40,000 kW at a new station at Morsil. Utilization of the Ruver Ljusnan will be augmented by three new installations at Krokstrommen (47,800 kW), Donje (39,000 kW), and Ljusne Strommar (33,000 kW).

Prospects in Ireland

In a statement by the E.S.B. it is pointed out that the position this winter and next will be difficult, but the building of new power stations has at last progressed sufficiently to bring promise of adequate supplies for all. In about 1954 there will be a total of eleven stations—six water-power two turf-fired, and three coal or oil fired. Five new stations are in various stages of building, two of which will generate from the waters of the Erne, two from turf at Portarlington and Allenwood, and one at Ringsend from coal or oil. One of the new turf stations is expected to be in commission early in 1950.

N.E. Extensions

Durham County Council has approved plans by the North Eastern Electricity Board for the following extensions: 66 kV overhead line from Haverton Hill to Seal Sands, Billingham; 20 kV overhead line to supply the Eaglescliffe Chemical Co., Urlay Nook, near Darlington; l.v. line in connection with supplies to the village of Coatham Mundeville; l.v. line to supply Heighington; and overhead and underground cables for supplies to Sheraton village.

Lighting Contract

The Eastern Electricity Board (Chilterns Sub-Area) has received an order from the Aylesbury Borough Council for 22 mercury vapour lamps and columns for improved lighting in Buckingham Road.

Trolley-buses in New Zealand

The Christchurch (New Zealand) Tramway Board has decided upon a plan of modernization and proposes to purchase 40 trolley-buses and erect new buildings for the conversion of two routes. For this purpose it is seeking to raise a loan of £532,000.

Photo-electricity

Brief Survey of Light Sensitive Elements

At the present time photocells are enjoying an increasing popularity in industry and are being used to advantage in all manner of controlling and measuring apparatus. In view of this, some purpose may be served by outlining the construction, theory of operation and characteristics of the various types which are available.

The three most important phenomena associated with photo-electricity are the generation of an e.m.f. between two electrodes when either of them or the intervening medium is illuminated; the reduction of the resistance of materials by exposure to light; and the emission of electrons from illuminated surfaces. These effects are the basic working principle of photo-voltaic or barrier layer cells, photo-conductive or selenium cells and photo-emissive cells respectively.

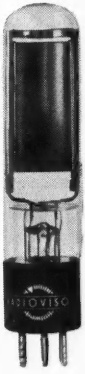


Photo-voltaic Cells

There are two main types of photo-voltaic cells and in one of them copper oxide is used for the sensitive surface, this being prepared by heating a copper disc until a thin film of oxide is formed on both sides. The disc is then quenched and the oxide removed from one side. When illuminated, an e.m.f is generated at the junction of the oxide film and copper base, electrical connections to the device being made by means of the latter and a metal grid pressed into contact with the oxide film. With the other type of cell, which is, incidentally, generally used in preference to the above-mentioned cell as its spectral response approximates so closely to that of the human eye, a thin film of selenium is deposited on an iron disc and covered with a transparent coating of gold, platinum or silver.

The current output of these is reasonably large but because of their low resistance it cannot easily be amplified. Conquently they are seldom used for relay operation but are incorporated in light-measuring instruments such as photographic exposure meters, the cell being directly connected to a microammeter. Care must be taken of such instruments because cells become fatigued if exposed to light sources of excessive intensity.

Photo-conductive Cells

As a result of investigations which were carried out during the latter half of the last century, it was discovered that the resistance of selenium decreased when it was illuminated. The outcome of this work was the development of the photo-conductive selenium cell, the resistance of which varies according to the intensity of the light falling on it.

The three main types of photocells as made by Radiovisor Parent, Ltd. (Top left) Photo-emissive. (Above) Photo-voltaic or barrier layer. (Left) Photo-conductive (selenium)

Cells of this type which are available to-day comprise a flat glass plate measuring about 1.25in by 0.5in into one surface of which are fused two gold electrodes. The surface of the glass and the electrodes is coated with selenium and two clips are attached to the sides of the plate to serve as electrical connections and as a means of mounting the assembly in a sealed glass envelope.

In practice, photo-conductive cells are connected in series with a small voltage source, and as the current flow is in terms of a few μA, the voltage across the

cell is stepped up either by a magnetic or valve amplifier in order to provide enough power to operate a relay or other equipment. As they have a larger current output than other light-sensitive elements, these cells are successful for ordinary switching operations, but they are not, however, suitable for incorporation in accurate light-measuring instruments. During a period of thirty years or so they lost ground in favour of photo-emissive cells and the more advanced types of photo-voltaic cells, but during the recent war they attained renewed importance, particularly as high-sensitivity infra-red detectors.

Photo-emissive Cells

Photo-emissive, or photo-electric cells as they are more usually called, work on a similar principle to radio valves with the difference that electrons are emitted from a cold cathode at a rate depending upon the intensity of light falling on its surface. The light-sensitive surface of the cathode is usually one of the alkali metals such as caesium, but alkaline earth metals or a physical or chemical compound of an alkali or alkaline earth is also used.

The cathode is mounted in a glass envelope adjacent to the anode, which may be in one of a variety of forms; and it is arranged to be at a potential positive with respect to that of the former. Thus, any electrons emitted by the cathode are attracted to the anode, causing a current to flow in the external circuit.

The glass envelope containing the electrode assembly may either be evacuated or filled with gas. In the latter case amplification takes place as the electrons from the cathode collide with the atoms of gas, thereby releasing further electrons and causing a greater current to flow in the external circuit than would have been the case with an evacuated cell.

A disadvantage of gas-filled cells is that their output is not strictly proportional to the light intensity at the cathode. The evacuated cell on the other hand has an output proportional to illumination.

Under conditions of equal illumination photo-conductive cells have greater outputs than photo-emissive cells, so the latter must almost always be used in conjunction with some form of amplifier.

Another point of interest with regard to photo-emissive cells is that by suitable choice of the cathode material cells can be produced which are sensitive to different wavelengths or colours of light.

Next Week's Events

Monday, 2nd January

BIRMINGHAM.—James Watt Memorial Institute, 6 p.m. I.E.E. South Midland Centre. "The Performance of the British Grid System in Thunderstorms," by Dr. J. S. Forrest.

CARDIFF.—South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. "The Application of Frequency Modulation to V.H.F. Multi-Channel Radiotelephony," by J. H. H. Merriman and R. W. White.

LIVERPOOL.—Liverpool Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "Hot-Cathode Thyratrons: Practical Studies of Characteristics," by H. de B. Knight.

Tuesday, 3rd January

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "Radar Echoes from Precipitation," by J. E. N. Hooper and A. A. Kippax.

Wednesday, 4th January

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, 6.30 p.m. I.E.E. Tees-Side Sub-Centre. "Development and Design of Electrical Control Gear for Machine Tools," by A. R. H. Thorne.

NEWCASTLE-ON-TYNE.—Minor Durant Hall, Oxford Street, 6.15 p.m. I.E.S. Newcastle Centre. "Church Lighting," by L. C. Rettig.

SOUTHAMPTON.—University College, 6.30 p.m. I.E.E. Southern Centre. "An Oscillograph for Automatic Recording of Disturbances on Electric Supply Systems," by W. T. J. Atkins.

Thursday, 5th January

LONDON.—Savoy Place, London, W.C.2, 5.30 p.m. I.E.E. Utilization Section. "Some Problems in Aircraft Magneto Development," by R. T. Coe and D. F. Welch.

Friday, 6th January

BIRMINGHAM.—Imperial Hotel, Temple Street. Illuminating Engineering Society (Birmingham Centre). Annual dinner.

NEWCASTLE-ON-TYNE.—King's College, 7 p.m. I.E.E. North Eastern Students' Section. Film "Atomic Physics."

Saturday, 7th January

BIRMINGHAM.—Grand Hotel, 3 p.m. Birmingham Electric Club. Children's party.

LEEDS.—Yorkshire Electricity Board's offices, Whitehall Road, 2.30 p.m. I.E.E. North Midland Students' Section. Main Centre chairman's address, by J. R. Rylands.

FINANCIAL SECTION

Company News — Stock Exchange Activities

Reports and Dividends

S. Smith & Sons (England), Ltd., held their annual meeting on 21st December, when Sir Allan Gordon-Smith (chairman), who presided, in referring to the company's subsidiaries, said that Smith English Clocks, Ltd., had manufacturing facilities which, when fully developed, would make it the largest combined clock and watch manufacturing concern in the world. To-day they were turning out clocks and watches at the rate of 20,000 per day, a large percentage of which was for export.

Aerialite, Ltd.—The annual meeting was held on 21st December, Mr. L. S. Hargreaves (chairman), presiding. In his circulated statement the chairman says that they have exported approximately 26 per cent of their products during the year, some in the dollar area. Their subsidiary, Victor H. Iddon, Ltd., has earned less profit than last year, mainly due to lower prices and higher costs, but it has shown a reasonable profit for the capital invested. Good progress is being made by their South African subsidiary, Aycliffe Industries, Ltd.

Marco Refrigerators, Ltd.—The annual meeting was held on 21st December. In his circulated statement, Mr. A. E. Leach (chairman and managing director), says that while the volume of sales has increased, the change-over to the buyers' market has involved a lowering of prices and an increase in selling costs. The position has been mitigated by economies in cost brought about by the operation of the Byfleet factory and a consequent relative overall reduction in outside purchases of goods and services.

Telephone Rentals, Ltd., has declared an interim dividend of 4 per cent (unchanged).

Solus Teoranta (the Irish lamp-making concern) is again paying an interim dividend of 5 per cent.

New Companies

Ferrovolt, Ltd.—Registered 22nd November. Capital £5,000. Agency or agencies for the import, export, purchase and sale of general engineering, electrical and industrial equipment, etc. Subscribers: C. H. Cole and J. A. Ramsey. Solicitors: J. A. Ramsey and Co., 130, Leadenhall Street, E.C.3.

Quick Release Terminals, Ltd.—Registered 29th November. Capital £1,000. To carry on the business of manufacturers and repairers of and dealers in dynamos, motors, armatures, magnetos, batteries, etc. Regd. office: 26, Norman Crescent, Shoreham-by-Sea.

Ironcrafts Electrical Co., Ltd.—Registered 7th December. Capital £400. Mechanical, electrical, agricultural and general engineers, etc. Directors: L. G. Amsdon and A. C. Glennerster. Regd. office: 5, Leys Avenue, Letchworth, Herts.

Veron Electric, Ltd.—Registered 6th December. Capital £5,000. Directors: P. M. Edinborough and E. Edinborough. Regd. office: 28/9, Worcester Street, Kidderminster.

Brandenberg Designs, Ltd.—Registered 10th December. Capital £1,000. Electrical designers and manufacturers of and dealers in electronic equipment, etc. Directors: E. G. Blohm, Count G. P. Zaluski and E. A. K. Lowe. Regd. office: 168, Cromwell Road, S.W.5.

John Bowen Fittings, Ltd.—Registered 8th December. Capital £500. Dealers in and manufacturers and repairers of electrical fittings and appliances, etc. Directors: J. H. Bowen and Elsie A. Bowen. Regd. office: 63, Ifield Rd., S.W.10.

Pleasure Radio, Ltd.—Registered 30th September. Capital £500. Manufacturers of and dealers in electrical and mechanical apparatus, accessories and components, particularly radio sets and valves, television sets, etc. Directors: G. T. L. Nash, J. Jewkes and M. D. Blick. Regd. office: 194, Albert Road, Handsworth, Birmingham.

Planet Recordings, Ltd.—Registered 15th December. Capital £250. Manufacturers and repairers of and dealers in electrical and mechanical apparatus and accessories, wireless and television sets, etc. Directors: B. Okrent and P. Okrent. Regd. office: 16, Stamford Hill, N.16.

Liquidations

Pritchett Manufacturing Co., Ltd.—Winding up voluntarily. Liquidator Mr. W. Le'R. Hand, Fletcher's Chambers, Fore Street, Birmingham, 2.

Bankruptcies

E. W. Chapman, London House, King Street, Market Rasen, Lincs., electrical engineer.—Public examination 9th February at the Guildhall, Lincoln.

FINANCIAL SECTION

STOCKS and SHARES

THE closing days of 1949 have found Stock Exchange market in a chastened, not to say a subdued, mood. That business should be very quiet is only natural at this time of year. Investment and speculation lie dormant; the window dressing process continues up to New Year's Eve. After that it is usually considered that money held previously in the banks would flow into Stock Exchange markets, but even this convention is subject to the feeling of caution which is everywhere apparent among the investors.

Industrials and Gilt-edged

For the third year in succession, circumstances have kept most markets on the retreat. According to the indices, the year's depreciation in the leading industrials has amounted, on the average, to about 15 per cent. Since the Stock Exchange market finally boiled over at the end of 1946, the total drop is something akin to 30 per cent. Matters are substantially worse in some of the speculative departments. Industrials laboured throughout under the continuation of the dividend limitation agreement, reinforced by the need to conserve working capital depleted by taxation and high price levels. In the gilt-edged market the British Electricity 3 per cents have fallen since January from 103 to 95½ for the 1968/73 stock, and from 101½ to 94⅛ for the 1974/77 issue.

Communications

The event of the year in this section was the appearance and rejection of the Cable & Wireless reorganization scheme. The ordinary stock reflects hopes of a satisfactory outcome, but the preference faces repayment at par:—

Stock or Share	23rd Dec. 1948	23rd Dec. 1949	Rise or Fall
Anglo-Amer. Pref. ...	122½	95	−27½
Cable & Wireless Pref.	125½	99	−26½
Do., Ord.	215	251	+36
Great Northern ...	21	14	− 7
Marconi Marine ...	31/-	25/-	−6/-

Electrical Equipment Shares

As usual, the leading electrical equipment shares have fought a rearguard action against the odds. As this table shows, the fall in prices has been kept within fairly reasonable bounds:—

Company	23rd Dec. 1948	23rd Dec. 1949	Fall
	s d	s d	s d
Associated Elec. Ind....	78 3	70 0	8 3
Crabtree Electrical ...	43 0	32 6	10 6
Crompton Parkinson ...	27 6	24 6	3 0
Elec. Construction ...	53 9	46 6	7 3
English Electric ...	48 9	42 6	6 3
G.E.C.	90 0	74 6	15 6
Revo	60 9	45 0	15 9
Reyrolle	61 3	57 6	3 9

Cables and Telephones

With the aid of a consistently good set of reports and dividends, and of active business news, this section of the electrical market has again served shareholders comparatively well. Johnson & Phillips and Telephone Construction issued one-for-four capital bonuses and the approximate value of the "rights" is allowed for in the last column of this table:—

Company	23rd Dec. 1948	23rd Dec. 1949	Rise or Fall
	s d	s d	s d
Automatic Telephone...	63 3	54 6	−8 9
British Insulated Callender's	36 0	32 0	−4 0
Enfield Cable	36 0	28 3	−7 9
Ericssons	45 0	40 0	−5 0
Henley's	25 0	22 6	−2 6
Johnson & Phillips ...	70 6	60 9	+4 6
Siemens	35 6	30 0	−5 6
Telegraph Construction	48 9	36 3	−3 0
Telephone Manufacturing	10 3	8 6	−1 9

Miscellaneous

In the light engineering sections of the market depression has been general although a growing interest in television has done something lately to strengthen prices of radio shares. Experience in other electrical fields has been mixed, as this table shows:—

Company	23rd Dec. 1948	23rd Dec. 1949	Fall
	s d	s d	s d
Brush	7 3	6 3	1 0
Cossor	11 0	8 6	2 6
Decca	22 9	12 6	10 3
E.M.I....	20 6	18 0	2 6
Ever Ready	37 0	28 6	8 6
Tube Investments ...	6 11/16	5 7/8	16 3
Walsall Conduits ...	57 6	53 9	3 9

Investment prospects for the New Year are blocked in the foreground by the General Election and anyone taking a view round that event will still have difficulty in discerning a clear path out of the wood.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s each) may be obtained from the Patent Office, 25, Southampton Buildings, W.C.2.

1945

2647. British Thomson-Houston Co., Ltd.—Apparatus for controlling a sequence of operations. 5th February, 1944 (633054.)

1946

1852. Telefonaktiebolaget L. M. Ericsson.—Telephone receivers. 22nd January, 1945. (633337.)

4098, 4100. Sigmund, F., and Hlavin, W. S.—Winding elements of electrical machines. 9th February, 1946. (633125/6.)

7215. Kent, Ltd., G., and Medlock, R. S.—Electrical measuring apparatus. 7th March, 1946. (633127.)

8351. British Thomson-Houston Co., Ltd.—Magnetic recording apparatus. 21st March, 1945. (633063.)

17257. Standard Telephones & Cables, Ltd.—Radio direction finder. 20th June, 1945. (Addition to 632948.) (633067.)

23008. Compagnie Générale d'Electricité.—Telecommunication installations. 9th June, 1945. (633068.)

23300. British Thomson-Houston Co., Ltd.—Overload protective devices for liquid insulated electrical apparatus. 6th August, 1945. (633069.)

26160. Naamlooze Vennootschap Philips' Gloeilampenfabrieken.—Method of manufacturing blocking-layer cells of the selenium type. 22nd February, 1943. (633346.)

27060. Collins Radio Co.—Multi-frequency generating and selecting systems. 27th February, 1946. (633071.)

27127. Soc. Le Carbone-Lorraine.—Method of manufacturing electrical contact brushes. 17th November, 1942. (633073.)

29616. Submarine Signal Co.—Distance and direction measuring systems. 15th June, 1943. (633352.)

29861. British Thomson-Houston Co., Ltd. (General Electric Co.).—Frequency dividing apparatus. 7th October, 1946. (633074.)

30919. Standard Telephones & Cables, Ltd., Earp, C. W., and Godfrey, R. M.—Radio-position indicating systems. 17th October, 1946. (633076.)

32546. Scophony, Ltd., and Adams, A. E.—Multiple trace recording devices. 1st November, 1946. (633079.)

33555. Mansford, H. L., and Scantlebury, G. S. P.—Cathode-ray oscillograph apparatus. 12th November, 1946. (633081.)

35296. Westinghouse Electric International Co.—Regulating systems for dynamo-electric machines. 29th November, 1945. (Cognate application 35297/46 and 35298/46.) (633085.)

37272. Siemens Electric Lamps & Supplies, Ltd., and Griffiths, W. F.—Fittings for tubular electric lamps. 18th December, 1946. (633090.)

1947

438. General Electric Co., Ltd., and Friedlander, E. S.—Electric alternators. 6th January, 1947. (633091.)

2835. Marconi's Wireless Telegraph Co., Ltd.—Electrical wave generating apparatus. 30th January, 1946. (633362.)

4822. Naamlooze Vennootschap Philips' Gloeilampenfabrieken.—Stator for dynamo-electric machines. 2nd February, 1944. (633364.)

5045. Marconi's Wireless Telegraph Co., Ltd.—Radar systems. 25th June, 1941. (633096.)

5331. Swansea Sheet Metal Engineers, Ltd., and Davies, L. C.—Protection of pipes, electric wiring cables and the like. 24th February, 1947. (633365.)

5777. Newman, E. A.—Electrical circuit-arrangements for the generation of oscillations. 28th February, 1947. (633366.)

6019. Harley, M. C.—Electric lamps particularly for aircraft. 3rd March, 1947. (633367.)

7001. Standard Telephones & Cables, Ltd., and Grayson, H.—Electric counting circuits. 13th March, 1947. (633099.)

7144. Standard Telephones & Cables, Ltd.—Time base generator, 20th March, 1946. (633368.)

7573. Kolster-Brandes, Ltd., Montgomery, W. A., and Rogers, E. A. J.—Television receivers, 19th March, 1947. (633100.)

8148. Landis & Gyr Soc. Anon.—Manufacture of an electricity meter. 26th March, 1946. (633103.)

8887. Standard Telephones & Cables, Ltd.—Frequency generating systems. 15th February, 1946. (633369.)

9584. Philips Lamps, Ltd.—Coils comprising a core of ferro-magnetic material. 13th April, 1946. (633107.)

10888. Turnbull, F.—Protectors for the heating elements of fires employing radiating heating elements. 23rd April, 1947. (633110.)

10893. Joglekar, G. D., and Verman, L. C.—Methods of and apparatus for magnetic separation. 4th May, 1946. (633373.)

11454. Standard Telephones & Cables, Ltd., and Wright, E. P. G.—Telecommunication exchange systems. 29th April, 1947. (633112.)

11773. Marconi's Wireless Telegraph Co., Ltd.—Electron-discharge tubes. 31st May, 1946. (633376.)

11848. Sperry Products, Inc.—Supersonic inspection apparatus. 21st May, 1946. (Addition to 625267.) (633144.)

12337. Schaffer, W.—Radiosondes. 7th May, 1947. (633113.)

14310. Naamlooze Vennootschap Philips' Gloeilampenfabrieken.—Means for indicating or recording pressure. 16th May, 1944. (633148.)

15647. Standard Telephones & Cables, Ltd.—Transmission measuring system for carrier-wave cable systems. 12th February, 1944. (633383.)

15667. British Thomson-Houston Co., Ltd.—Methods of preparing 2-ethyldibenzofuran. 13th June, 1946. (633151.)

16430. Page, A.—Lamp shades and lamp shade holders. 21st June, 1947. (633155.)

16658. Metropolitan-Vickers Electrical Co., Ltd., and Hardie, A. M.—Apparatus for determining characteristics of electric-discharge devices. 24th June, 1947. (633156.)

18673. General Electric Co., Ltd., and Dauncey, L. A.—Methods of, and apparatus for, manufacturing synthetic jewels. 14th July, 1947. (633118.)

19128. Telegraph Condenser Co., Ltd., and Sporing, P. A.—Connecting means for electrical apparatus. 17th July, 1947. (633387.)

19736. Auth Electric Co., Inc.—Chime signals. 16th December, 1938. (633163.)

21212. British Thomson-Houston Co., Ltd.—Methods of recovering silver from residues containing the same. 7th August, 1946. (633119.)

21326. Dennis, H. P., and Dennis, J. P.—Quick make-and-break electrical switches or circuit-breakers. 6th August, 1947. (633392.)

21460. Sylvania Electric Products, Inc.—Fluorescent lamp fixture. 19th July, 1940. (633168.)

21695. Sylvania Electric Products, Inc.—Glass tube baking apparatus. 28th May, 1941. (633171.)

22580. Crabtree & Co., J. A., Besag, E., Hill, W. E., and Wintle, T. D. G.—Electromagnetically operated switches and contacts therefor. 14th August, 1947. (Cognate applications 22586/47, 4733/48 and 4734/48.) (633393.)

22583, 22584 and 22587. Crabtree & Co., Ltd., J. A., Besag, E., Hill, W. E., and Wintle, T. D. G.—Electromagnetic switches. 14th August, 1947. (633394/6.)

23184. Standard Telephones & Cables, Ltd., Barnard R. M., and Delves-Broughton, J.—Electric condensers. 21st, August, 1947. (633121.)

23822. Forges et Ateliers de Constructions Electriques de Jeumont.—Systems for signalling and eliminating faulty electric circuits. 13th November, 1945. (633399.)

24316. Moore, W. E.—Top-charged electric furnace. 12th May, 1944. (633122.)

25223. Landis & Gyr Soc. Anon.—Electric selector switches or receiving devices for remote-control installations. 9th September, 1946. (633195.)

28238. Anglo-Iranian Oil Co., Ltd., and Beaumont, F. N.—Alternating-current welding apparatus. 22nd October, 1947. (633186.)

31476. English Electric Co., Ltd., and Caldbeck, C. J.—Motor control systems. 27th November, 1947. (633212.)

31948. Worthington-Simpson, Ltd., Southern, J., and Cherrie, C. M.—Electric motor-driven submersible pumping units. 3rd December, 1947. (633189.)

32070. Soc. d'Exploitation de Brevets.—Dynamo testing plants. 12th September, 1945. (633214.)

35034. Ratsey, O. L., Rosenberg, W., and Buckingham, J.—Screened electric cables. 31st December, 1947. (633190.)

35086. General Electric Co., Ltd., Roberts, D. A. E., and Willshaw, W. E.—Power-measuring arrangements for high-frequency electrical oscillations. 31st December, 1947. (633220.)

1948

3237. Lucas, Ltd., J., and Winkley, A. W.—Alternating electric current generators. 4th February, 1948. (633238.)

3346. Hollander, J. M.—Means for supplying electrical power to a movable electrically operated apparatus. 5th February, 1948. (633243.)

3551. General Electric Co., Ltd., Angell, B. L. C., and Hopkins, S. E.—Inductances provided with variable-position contact members. 6th February, 1948. (633249.)

3658. Stubbs, A. D.—Apparatus for the closing and opening of electrical circuits by variation of liquid level in tanks, wells, boreholes, reservoirs, sewage chambers and the like. 9th February, 1948. (633253.)

4046. General Electric Co., Ltd., and Reeman, J.—Gas turbine installations. 11th February, 1948. (633272.)

4264. Standard Telephones & Cables, Ltd.—High voltage selenium rectifiers and manufacturing process. 15th February, 1947. (633275.)

4410. Austin Mills, Ltd., and Beavon, T. A.—Electric heaters. 16th February, 1948. (633284.)

4596. Thermostat Appliances, Ltd., and Douce, N.—Thermostatic switches. 17th February, 1948. (633289.)

4768. Metropolitan-Vickers Electrical Co., Ltd.—Electrical capacitors. 1st October, 1946. (633294.

4878. Parsons, Ltd., C. H., and Handley, G. B.—Electric-fuse holders and contacts therefor. 19th February, 1948. (633299.)

5094. Western Electric Co., Inc.—Cable-forming machines. 31st March, 1942. (633305.)

5306. Philips Electrical, Ltd.—High-frequency electric furnaces. 26th February, 1947. (633311.)

5631. General Electric Co., Ltd., and Coleman, A. S.—Electric lampholders. 25th February, 1948. (633318.)

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5658. Wild-Barfield Electric Furnaces, Ltd., and Ellis, C. C.—Furnace and other doors. 25th February, 1948. (Addition to 596070.) (633319.)

5758. Nordel Corporation.—System for electrical prospecting. 25th February, 1943. (Cognate application 5759/48). (633322.)

7702. Rotax, Ltd., and Hamilton, R. F. G.—Electric current supply systems. 13th March, 1948. (633333.)

1949

1386. Philips Electrical Ltd.—Circuits for generating phase-modulated oscillations. 9th November, 1945. (Divided out of 623060.) (633403.)

Amended Specifications

616063. General Electric Co., Ltd., & others.—High-frequency electric induction heating apparatus.

616996. Standard Telephones & Cables, Ltd., & others.—High-frequency dielectric heating.

Trade Marks

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered within a month of 14th December.

THE PHOENIX (design). No. 667,219. Class 9. Electric vacuum cleaning apparatus, electric flat irons and electric kitchen utensils included in Class 9.—Phoenix Telephone & Electric Works, Ltd., The Hyde, Edgware Road, London, N.W.

ABRASWELD. No. 673,082. AERISWELD. No. 673,083. STAINWELD. No. 673,097. TRANSWELD. No. 673,101. All Class 9. Electrodes for electric welding.—Lincoln Electric Co., Ltd., 45, Broadwater Road, Welwyn Garden City, Herts.

RONDO. No. 679,104. Class 9. Wireless apparatus and loudspeakers.—Willy Bürkle, Stuttgart, Germany. Address for service, c/o W. P. Thompson & Co., 50, Lincoln's Inn Fields, London, W.C.2.

BICALEX. No. 679,344. Class 9. Wires and metal strips, all insulated with enamel and being for electrical purposes.—British Insulated Callender's Cables, Ltd., Norfolk House, Norfolk Street, London, W.C.2.

IRAS. No. 680,725. Class 9. Electrical apparatus and instruments included in Class 9; scientific apparatus and instruments; and photographic and cinematographic apparatus.—Instrument Re-Conditioning & Sales, Ltd., Euston Chambers, Euston Grove, Morecambe, Lancs.

JIFEXTRA. No. 681,405. Class 9. Electric vacuum cleaners, and parts thereof and fittings therefor, all included in Class 9.—Water Softener & Vacuum Cleaner Service, Ltd., 248, Romford Road, Forest Gate, London, E.7.

VIEWFLEX. No. 681,925. Class 9. Flexible television aerials for indoor use.—Belling & Lee, Ltd., Cambridge Arterial Road, Enfield, Middx.

Raw Materials Guide

DETAILS of nearly 400 imported raw materials ranging from arsenic to diamonds are contained in a new edition of "Raw Materials Guide," which was published on 12th December, by H.M. Stationery Office for the Board of Trade. This 75-page guide (price 1s 6d) lists the main uses for each raw material together with the chief sources of supply for the United Kingdom, and gives information about import and export licences, and other Government controls.

Finnish Thermal Station

DESPITE rather ambitious water-power expansion schemes, Finland, like Sweden, is finding it hard to cope with the increased consumption. One result of this trend was an investigation by the Imatran Voima Oy power combine of sites for a large thermal power plant. A suitable one has been found at Iso-Vilisalo, where, at a total cost estimated at three billion Finnish marks (£1,500,000 roughly), it is now proposed to commence erection of a steam station to serve south-west Finland.

CONTRACT INFORMATION

ACCEPTED TENDERS AND PROSPECTIVE ELECTRICAL WORK

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section, the date of the issue is given in parentheses.

Australia.—BRISBANE.—27th January. City Council. Supply of 30,000 10A watthour meters. (C.R.E. (I.B.) 36408/49. Ten/833.)*

2nd February. City Electric Light Co., Ltd. Electrical instruments, control gear and panels. (C.R.E. (I.B.) 36374/49. Ten/836.)*

Chester.—6th February. City Council. Electrical installation in county secondary modern school, Hardbridge. (23rd December.)

Cleethorpes.—5th January. Corporation. Electrical installations in three blocks of cottage flats. (See this issue.)

New Zealand.—WELLINGTON.—21st March. State Hydro-Electric Department. 500 MVA, 11,000 V switchgear. (C.R.E. (I.B.) 36354/49. Ten/838.)*

Southport.—16th January. Corporation. Installation of floodlighting and decorative tree lighting. (See this issue.)

Orders Placed

Birmingham.—Regional Hospital Board. Recommended. Reinstatement of electrical installations at the Robert Jones and Agnes Hunt Orthopædc Hospital (£2,860).—Thomas Wood & Sons (Chester), Ltd.

Middlesbrough.—Corporation. Recommended. Electrically operated hospital lift, loading capacity one ton (£1,255).—Austin Lifts, Ltd.

Portsmouth.—Corporation. Recommended. Renewal of the electrical installation at South Parade Pier (£2,655).—Neon (Portsmouth), Ltd.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Alnwick.—Houses on east and west sites at Howling Lane for the U.D.C.; G. Beaty, surveyor.

Amblecote.—Flats for U.D.C.; Webb & Grey, architects, High Street, Dudley.

Blyth.—Houses (86), Newsham Road; D. W. Foster, borough engineer.

Bournemouth.—Extensions to Municipal College, Shelley Park; education Officer, Town Hall.

Bowland.—Houses (48), various sites; J. Hinchliffe, R.D.C. surveyor.

Bristol.—Factory, Brislington Trading Estate; Verreccia & Sons (Bristol), Ltd., 3, St. Augustine's Parade.

Caernarvonshire.—School, Bodfeurig; county architect.

Alterations at Treborth Hall (£14,827); H. E. Williams, Bangor.

Caernarvon.—Police headquarters, Plas Maes Incla (£25,000); W. Rees Davies, surveyor, Guildhall.

Cardiff.—Warehouses and offices, West Canal Wharf; Stewarts & Lloyds, Ltd., Hannah Street.

Offices, Greyfriars Road; National Coal Board, Cambrian Buildings, Mount Stuart Square.

Carlisle.—Flats (40), Upperby estate for the City Council; direct labour.

Caterham.—Modernization of kitchen at St. Lawrence's Hospital (£38,000); South West Metropolitan Regional Hospital Board, 11a, Portland Place, London, W.1.

Chelmsford.—Flats, Woodhall estate; Roff Marsh, architect, 109, London Road.

Cheltenham.—Showrooms, offices and flats, 18/22, Suffolk Street; Leckhampton Estates, Ltd., Barn Meadow, Winchcombe.

Flats (42), Rowanfield estate; Geo. Wimpey & Co., Ltd., builders, Tilehouse Lane, Denham, Middx.

Cheshire.—Branch library, Oakwood estate, Stalybridge; county architect, The Castle, Chester.

Chester.—Houses (176), Great Saughall; C. Bridge, surveyor, 16, White Friars, Chester.

Chesterfield.—Fire station; county architect, Derby.

Chichester.—Extensions to east and west wings, County Hall; F. R. Steele, county architect, County Hall, Chichester.

Clacton.—Girls' secondary school (£76,017); C. H. Chaston & Co., builders, Holland-on-Sea.

Coalville.—Houses (80), for U.D.C.; F. Perks & Son, Ltd., Long Eaton, Notts.

Connah's Quay.—Houses (40), Red Hall site; E. C. Evans, clerk to U.D.C., Connah's Quay, near Chester.

Coventry.—Large factory extensions, Foleshill Road; Courtaulds, Ltd., rayon manufacturers.

Primary school at Stoke House; E. Harris & Son (Coventry), Ltd.

Crawley.—Standard factories, Crawley New Town (£37,000); Holloway Bros. (London), Ltd., builders, Bridge Wharf, Millbank, S.W.1.

Dorchester.—Sausage factory, South Street; J. H. Dewhurst, Ltd., 14, West Smithfield, London, W.C.1.

Douglas (I.o.M.).—Houses (224), Willaston estate; borough engineer.

Dudley.—Houses (330), Sledmere site; Webb & Gray, architects, 200, High Street.

Factory, Birmingham Road; Grainger & Smith, Ltd., King Street.

East Retford.—Houses (92); Walter Firth, Ltd., builders, Armthorpe Road, Doncaster.

* Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, S.W.1. Victoria 9040.

Edinburgh.—Houses (212), The Inch, off Old Dalkeith Road; J. Storrar, town clerk, City Chambers.

Falkirk.—Sisters' and nurses' quarters, Falkirk & District Royal Infirmary, for Hospitals Board of Management; M. D. Kennedy, secretary, 14, Princes Street, Falkirk.

Felling-on-Tyne.—Houses (50), near Wardley Hall, for the U.D.C.; Wimpey and Co., Ltd., builders, Jesmond, Newcastle-on-Tyne.

Glasgow.—Flats (1,988) and houses (556), Cranhill site; housing architect.

Shops and hall, Castlemilk Road; Mactaggart & Mickel, Ltd., 107, West Regent Street.

Gloucester.—Houses (56), Podsmead Farm estate; A. Morgan, city architect, Suffolk House, Greyfriars.

Grimsby.—Large bakery; Glentons, Ltd., 189, Freeman Street.

Guildford.—Nurses' home, Westover site (£68,000), for South-West Metropolitan Regional Hospital Board; Ward & Partners, architects, 33, Great George's Drive, London, S.W.1.

Hainault.—Joinery works, L.C.C. industrial estate; Bakers Joinery, Ltd., 51, Middlesex Wharf, London, E.5.

Hexham.—Houses (40), Priestlands, for the U.D.C.; J. W. Hanson and Son, architects, 123, Northumberland Street, Newcastle-on-Tyne.

Huddersfield.—Day nursery, Leeds Road; G. Graham, Sons & Co., 1, Tom Lane.

Hull.—Bank and offices, Paragon Street; Barclays Bank, Ltd., 54, Lombard Street, E.C.3.

London.—HENDON.—Flats, Abercorn Road (44) and Bittacy Hill (42); borough engineer.

POPLAR.—Primary school (£118,225) for L.C.C.; Tersons, Ltd., builders, 1, Seward Street, E.C.1.

SOUTHWARK.—Office block, 68/78, Newington Causeway; Wates, Ltd., 1258, London Road, S.W.16.

Malden & Coombe.—Flats (60), Newhouse Farm, South Lane; borough surveyor, Municipal Offices, New Malden, Surrey.

Mansfield.—Office block at Southwell Rd., West Mansfield, for Co-operative Society; Vallance & Westwich, architects, White Hart Street.

Musselburgh.—Houses (40), Market Street, with electrical work; burgh surveyor, Municipal Offices, High Street.

Newcastle-on-Tyne.—Municipal offices, Barras Bridge; G. Kenyon, city architect, 18, Cloth Market, Newcastle.

Nuneaton.—Central omnibus station; borough surveyor.

Peterborough.—Infants' school, Brewster Avenue, Woodston (£32,857); J. W. Barber & Son, builders, Church Street, Stanground, Peterborough.

Stockton-on-Tees.—Additions to the administrative block at Children's Hospital for Newcastle Hospital Board, Osborne Road, Newcastle-on-Tyne; staff architect to the Board.

Sunderland.—Methodist Church at Thorney Close; Rev. A. E. Fletcher, Minister-in-Charge, 10, Beechwood Street.

Wolverhampton.—Flats (94), Warstones Drive; director of housing, Town Hall.

Research Reports

AMONG the recent publications of the British Electrical and Allied Industries Research Association, Report G/XT129, "Gas Blast Circuit Breakers: Behaviour of Experimental Models at Reduced Pressures," by F. O. Mason, L. H. Orton and A. M. Cassie, deals with work aimed at identifying the cause of variation in the performance of an experimental gas blast breaker when deliberately operated at gas pressures well below those which are normally employed.

When the gas pressure is reduced step by step in these breakers, the onset of wholly unsatisfactory operation is not sudden, and it is shown that for each case there is a range of pressure in which variation in breaker performance occurs in a more or less random manner for apparently identical conditions of test.

The immediate object of the experimental work described was to test for the existence of some more or less marked degree of such variation rather than for the limits of its range, and in only one case so far was a prolonged series of tests made to determine limits.

The variation is discussed, and work is described which has been directed towards identifying its cause, which appears to be connected with the conditions characteristic of arcing under forced convection.

Another report, Reference G/T227, by L. Gosland and D. G. White, carries a stage further some earlier work of the E.R.A. by presenting calculated rates of rise of restriking voltage for practically all circuit breaker positions on a particular 66 kV system, which is referred to as System A. Work is in progress on obtaining similar information for further systems.

Copies of the above reports are available from the Association at Thorncroft Manor, Dorking Road, Leatherhead, Surrey, price 6s and 4s 6d respectively.

Unguarded Fire Danger

REMARKING that it was the seventh electric fire fatality he had investigated in the last few months, the Manchester city coroner (Mr. Jessel Rycroft) said at an inquest last week that regulations should be made to stop the manufacture and sale of electric radiators that had no guards. He had already appealed to the authorities to take action, and it was time somebody woke up and did something about it. A Fire Brigade officer said that the Home Office had called for reports of all fatal accidents involving electric radiators with a view to approaching the manufacturers.

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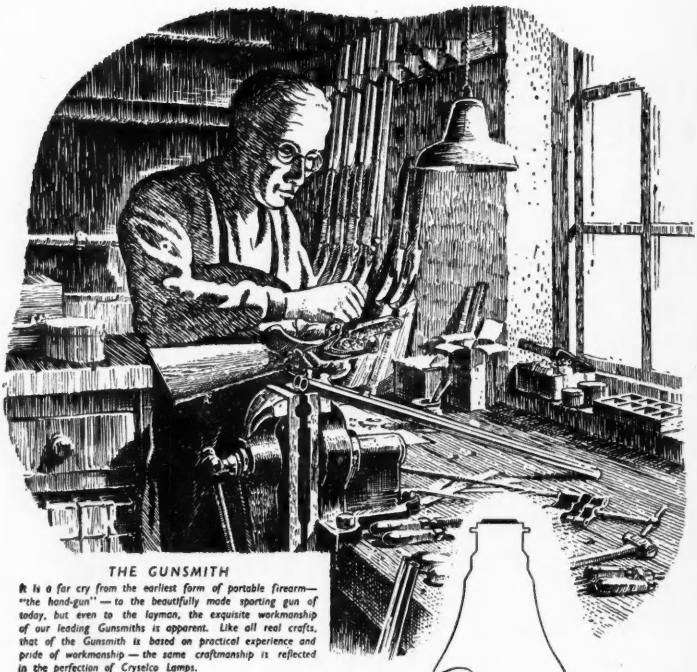

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